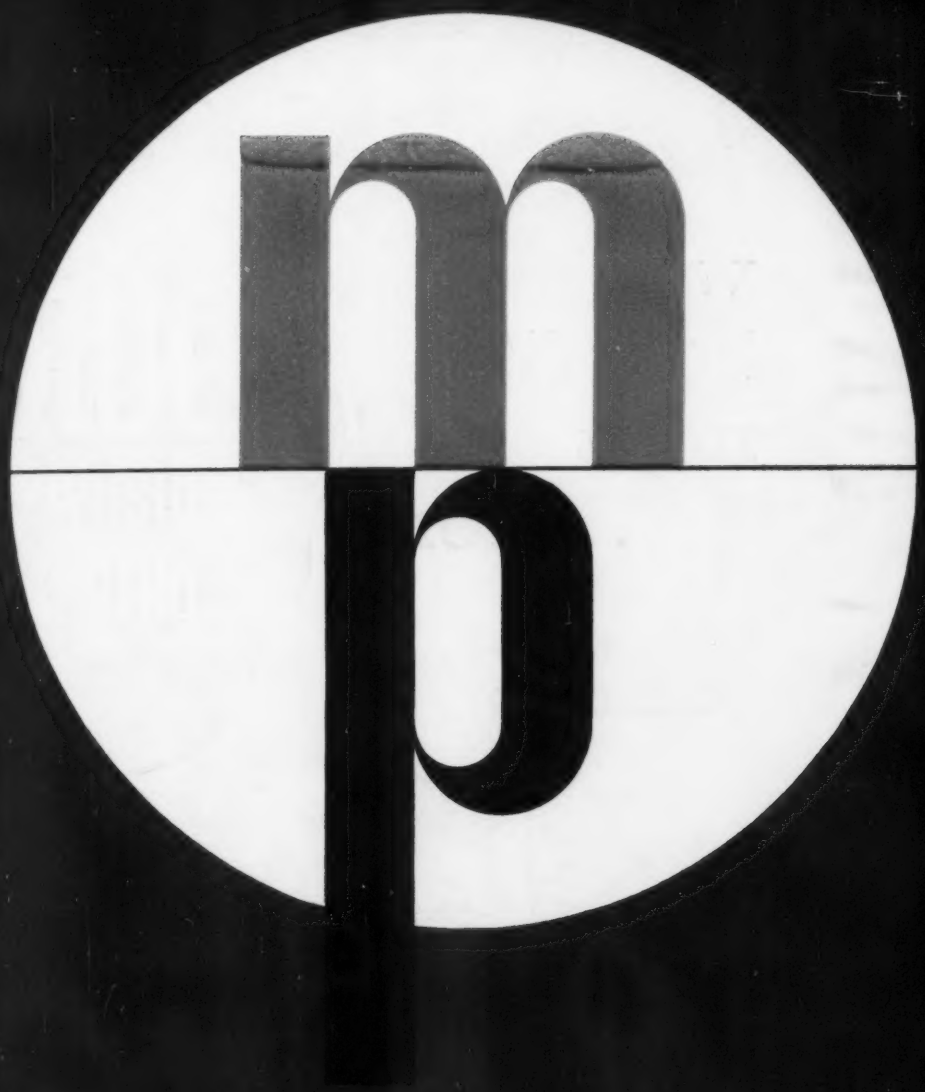
MODERN PLASTICS



October 1957

page 101 **How does world trade in plastics affect your business?**

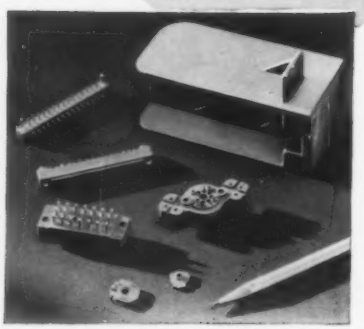
page 114 **Big new market— plastics furniture drawers**

MOLDERS like Durez diallyl phthalates because they handle well with little or no pampering in compression or transfer molding and in preheating. Existing molds can usually be used without modification.

ELECTRICAL ENGINEERS have found in diallyl phthalates a hitherto unavailable solution to problems involving retention of insulation resistance where performance is expected under high humidity and elevated temperature conditions. Dielectric constant and volume and surface resistivity after prolonged conditioning are particularly notable.

MECHANICAL ENGINEERS have found in these Durez materials an end to previous cracking problems, especially where large inserts are involved. Even in service at elevated temperatures, there is little or no after-shrinkage evident over a period of years.

who benefits most ...from DUREZ diallyl phthalates



ALL BENEFIT... from solutions to problems of insulation, dimensional stability, and arc resistance that have bothered manufacturers and molders for years. The Durez line of diallyl phthalate molding compounds provide an exceptional range of electrical properties enhanced by mechanical strength, heat resistance, and dimensional stability. Whichever suits your job best, the uniformity and quality of a Durez material will help you get results that meet your highest expectations. Send for data and a trial shipment of any or all of these:

DUREZ 16694 GREEN AND 18276 BLUE. Orlon-filled. Both are outstanding insulators. Negligible lifetime shrinkage. No after-bake required.

DUREZ 18783. Glass-filled. Impact strength, 15 ft./lb./in. Notable for dielectric properties, heat resistance. Suitable for highly intricate molding jobs.

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Plastics that Fit the Job

DUREZ PLASTICS DIVISION

HOOKER CHEMICALS PLASTICS

HOOKER ELECTROCHEMICAL COMPANY
1210 WALCK ROAD, NORTH TONAWANDA, N. Y.

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"Deskair"* is the modern office's answer to desk-doldrums . . . its dual-speed controls command a gentle zephyr or an invigorating stream of air . . . its tilt-screw directs this selected flow at the proper height to cool the thought-fevered brow or dispel tobacco smoke without scrambling all the papers on the working surface.

And CATALIN STYRENE is the answer to the need for a lightweight, strong material to mold the housing, impeller and knobs of this smartly designed, easily maneuvered little implement of atmospheric comfort.

Brown & Bigelow developed "Deskair" as one of a group of ingenious products which are molded of CATALIN STYRENE and marketed for use as business-building good-will gifts. Whatever the function for which a product is intended—wherever manufacturing operations call for a molded object or part that is sturdy and handsome in appearance . . . CATALIN STYRENE *breezes* home in front as the material of choice. Inquiries invited.

*Product of Brown & Bigelow, Minneapolis, Minnesota

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Catalin

In addition to Styrene, Polyethylene and Nylon Compounds, Catalin chemical products include a wide range of Urea, Phenolic, Cresylic, Resorcinol, and Melamine Resin formulations

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Number 2

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Another new development using

B.F.Goodrich Chemical *raw materials*

with Geon...

who needs alligators to sell jewelry

Handsome "alligator" jewelry display cases are now being made of Geon polyvinyl materials.

These attractive cases have the look of real leather—are actually better in many respects, but cost less. They are light and tough, take drops and bumps, resist scuffs and abrasion. Rigid vinyl sheeting made from Geon is pressure-formed for both base and lid and electronically bonded around a "core" of 100-point cardboard. Result—economical construction with the luxury look.

Versatile Geon is being made into a broad variety of containers and cases that can be transparent, textured, grained, brightly colored or opaque. Coatings, film sealants, tape, barrier materials and other products, too, are being made of Geon polyvinyl materials in the packaging field.

For technical information, write Dept. FQ-10, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Speidel Corp. display cases styled by Richard Arbib Co., are manufactured by Plaxall Inc., Long Island City, N. Y. Cases are thermoformed from vinyl sheet made by Nixon Nitration Works, Nixon, N. J. B.F.Goodrich Chemical Company supplies the Geon polyvinyl materials.

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B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

Classic decorated porcelain simulated for the first time in

NEW MELAMINE Schlitztap

NEW "SCHLITZTAP" consists of three melamine parts - handle collar, color band, and decorated section. These are assembled on a threaded aluminum rod and held between an anodized aluminum shank and crown. This striking draught-beer sales aid stands a handsome 12" high, carries two gay, five-color village street scenes. It looks like the finest bone china.

"Fused-in" decorations now possible on complex shapes, says Chicago Molded... and here's how it's done:

The design and production of the beautiful new "Schlitztap" is the result of more than two years of intensive research by the Jos. Schlitz Brewing Co., and by Hammer Bros., Inc. A solution to the complex problems involved in molding the tap handles was provided by Chicago Molded who engineered and molded the plastic parts.

A milestone in plastics technology, the "Schlitztap" represents the first time that a compound curved melamine surface has been decorated on a production-line basis. And with this type of decoration, the design is fused right into the melamine. It's virtually indestructible—immune to perspiration, scratching, staining or chipping.

Paves way for new applications. Most important, the "Schlitztap" represents a breakthrough for plastics into the field of decorated ceramics. It suggests parts ranging from decorated containers and giftwares, to lamp bases and door knobs—all made of beautiful, break-resistant melamine.

How it's done. Among the technical molding problems overcome by Chicago Molded was appearance of bubbles on the decorated surface, mottling of colors, and "burning out" of the pastel tones. Using a dual cycle operation, each piece is molded in a horizontal position on a 170-ton transfer press. During the first phase, melamine is forced into the die and allowed to pre-cure. The mold is then opened for positioning of two melamine foil overlays. Then there's a final curing cycle and the decoration becomes an integral part of the completed handle.

Whatever your plastic molding needs, you'll find it pays to call in Chicago Molded. CM engineers keep abreast of the progress in plastics, often *create* that progress to help you make your product more saleable. *That's why 66% of our business comes from firms we've served for over 20 years.*

For your free subscription to Plastics Progress, CM's magazine on up-to-date developments in plastics, write today to:

CHICAGO MOLDED
PRODUCTS CORPORATION
1046 North Kolmar Avenue, Chicago 51, Illinois

Editorial

A simple case of costs

At the Westinghouse presentation of its 1958 line of home appliances a special and most invigorating forum was held to which the company's suppliers were invited.

Keynoter J. W. Craig, vice president of the Electric Appliance Divs., in discussing the present price-profit squeeze in the home appliance manufacturing field, presented some figures which should be of vital interest to anyone having anything to do with plastics.

Based on the materials in an 11 cu. ft. refrigerator, here is what has happened to the costs of basic raw materials between 1947 and 1957.

Hot rolled steel	UP 87%
Cold rolled steel	UP 80%
Enameling iron	UP 78%
Copper	UP 50%
Aluminum sheet	UP 31%
Plastics (average)	DOWN 11.5%

The average price per pound paid by Westinghouse for plastics for refrigerator use in 1948 was 39 cents, in 1957 was 34½ cents. Small wonder that the plastics content of refrigerators has more than doubled over the past ten years!

Between 1947 and 1957 manufacturing costs in refrigerators at Westinghouse has gone up 11.4%, selling price has gone down 19.8%, so gross margin has been drastically reduced. Involved, of course, are many factors other than material costs. Rising labor costs, rising fringe benefit costs, and fierce competition in the home appliance field have all contributed.

The one bright light in the refrigerator manufacturing picture, and indeed, to some extent throughout the whole home appliance field, is the fact that plastics raw materials costs have been and are being lowered, and plastics processes are moving rapidly toward automation, with resulting lower labor costs per unit.

Mark of reader approval

The three letters "ABC" in the little logo cut below is the brand of the reader on MODERN PLASTICS. It means that this publication is a member of the Audit Bureau of Circulations, a voluntary, non-profit organization that sets standards for the definition and measurement of *paid* circulation. It means that the reader is boss.

Among plastics publications MODERN PLASTICS is the only one carrying this emblem.

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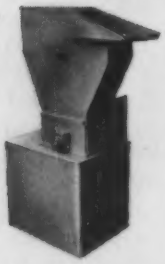
What grinding capacity do you need?

200 POUNDS AN HOUR



M-100

20" x 27" floor area
8" x 8" throat
hopper tray height: 49"
1½ HP motor

300 POUNDS AN HOUR

M-200

24" x 27" floor area
8" x 12" throat
hopper tray height: 49"
3 or 5 HP motor

400 POUNDS AN HOUR

M-300

30" x 31" floor area
8" x 16" throat
hopper tray height: 51¾"
7½ or 10 HP motor

ALL-STEEL GRANULATORS

outperform all other granulators of comparable size and cost

Grind all thermoplastic materials! **The famous B & J heavy duty knives with double shear knife action will handle the toughest materials – including vinyl and polyethylene – *without fluffing*. You can even feed hot and cold sprues simultaneously. And, because it has a large throat opening, your B & J Marvel Series Granulator will take large area rejects, gates, sprues, runners, etc., with ease.**

Easy cleaning! Sturdy construction! **Cleaning a B & J Marvel Series Granulator is truly "simplicity personified!" In seconds, the hopper and screen are detached (M-200 and M-300 hoppers are hinged for convenience), exposing the entire interior of the machine for quick, thorough cleaning. And, with its heavy all-steel frame, your B & J Marvel Series Granulator will take the "tough punishment" of day-in, day-out use with only minimum maintenance ever required.**

Simple operation! **The low tray height of the modern no-fly-back hopper makes feeding your B & J Marvel Series Granulator easy. The big, smooth sliding bin with its large sight glass speeds removal of the ground material. And, because it takes a minimum of floor space, you can use your B & J Marvel Series Granulator for beside-the-press as well as batch grinding.**

Lowest price for the performance! **Compare B & J Marvel Series Granulators with any other grinders on the market, and, you'll see what we mean. Dollar for dollar, you'll agree that your best buy is a B & J Granulator.**

Right now, you can see the difference, a B & J Granulator will make in your own plant. Write or phone for the full details of the B & J TRIAL TEST PLAN and additional details on any B & J Granulator.

GRINDING LONG EXTRUSIONS?
Ask about B & J's new exclusive hopper attachment that handles rejected extrusions, regardless of length, without pre-cutting.

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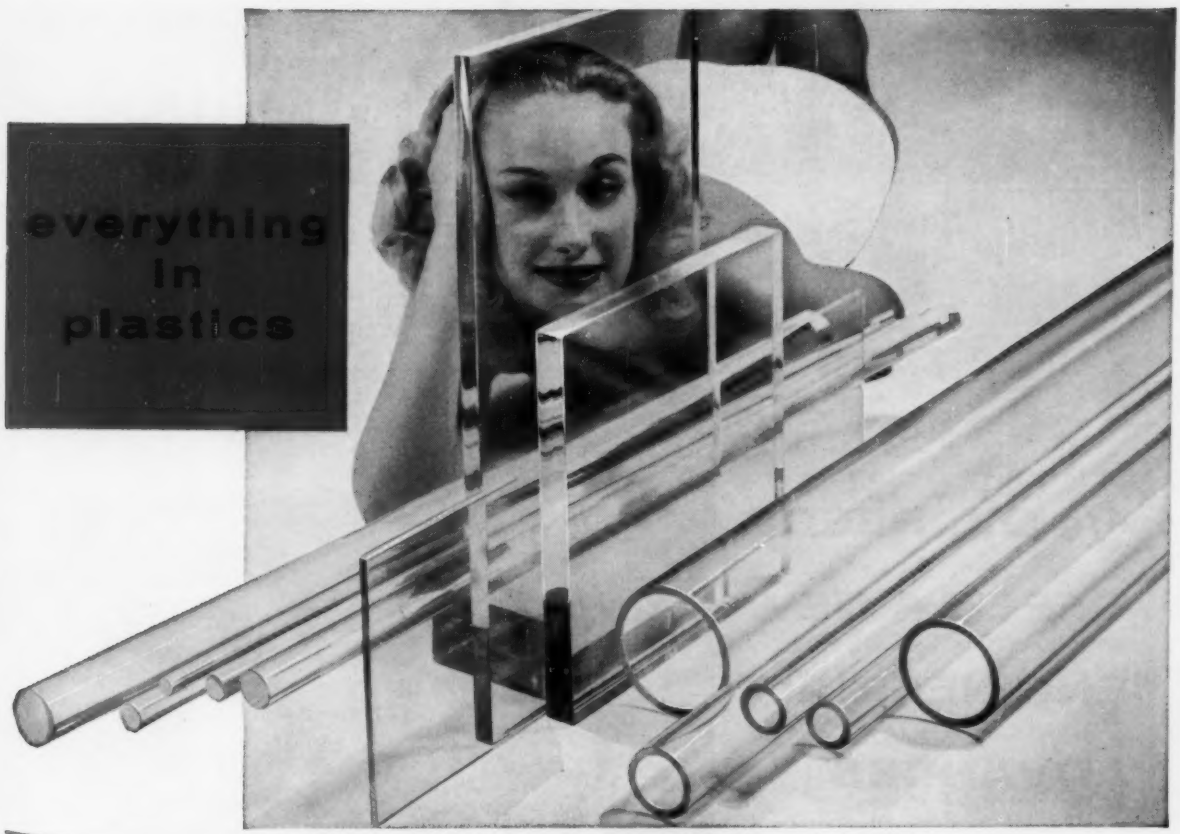
Exclusive Export Distributors: Omni Products Corp., New York, N. Y.



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☐ 157 Ways to use Plastics for maintenance.
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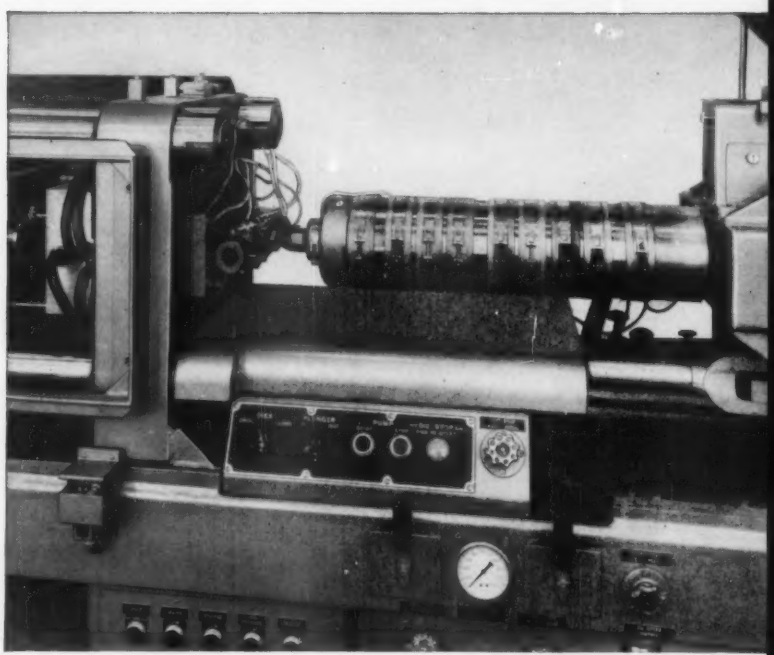
NEW REED FEATURES...

4/6 OZ. REEDS OFFER 4 NEW ENGINEERING ADVANCES



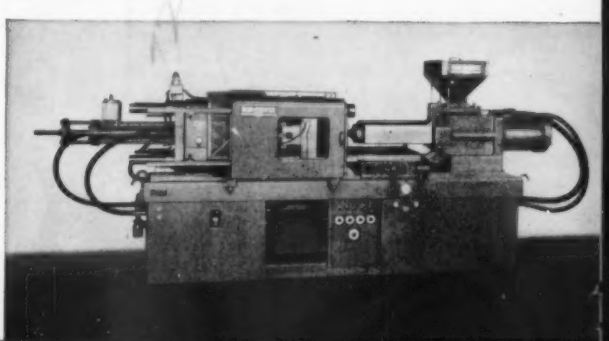
Here are the big new features that set today's 175T—4/6 oz. REED way out in front for high-speed, automatic operation:

New twin nozzle arrangement means faster, sprueless automatic molding. A Reed-Prentice exclusive, this multiple nozzle (shown above) makes it possible to use the 175T with a standard single nozzle when desired, increases the machine's versatility. Changing to this optional accessory can be done in minutes.

New Jumbo heating cylinder shown above has twice the capacity of a standard 175T heating cylinder. Available as optional equipment, the new Jumbo assures speedier plasticizing and more material for fast, automatic molding and heavy shots.

New high-torque, 15 H. P. motor is now standard equipment on the 4/6 oz. REED. It cuts dry cycle time to 5.7 seconds. In sustained production, a 175T with twin nozzles is now molding 2 one-pint containers on a 6-second cycle—1,200 pieces an hour.

New long-stroke 175 TL—4/6 oz. model (below) now provides infinite mold stroke adjustments between 6″ and 12″. It is ideal for deep draw containers.



Get complete information on these new REED features by calling your Reed-Prentice Sales Engineer today.

Engineered for Modern Molding

"YOU CAN'T BEAT NEW REEDS FOR AUTOMATIC OPERATION"

SAYS ERIK E. ERIKSON,
President of Detroit Plastic Products Company

"As far as I'm concerned," says Mr. Erikson, "the ideal production set-up would be new REEDS, running automatically. Of our 9 machines, 4 are less than two years old, and I plan to replace the others as rapidly as possible. I'm thoroughly sold on the benefits of these latest REED models—they're rugged, fast and well-designed. Using them on automatic operation, we've proved that we get high volume and quality at minimum cost, can improve production per machine as much as 25%."

Mr. Erikson has 8 of Detroit Plastics' 9 REEDS on one production line in this modern plant. In telling why he found the new REEDS so superior, he cited two examples: (1) a 175T—4/6 oz. machine that has run over 20,000,000 small nylon rollers with no trouble whatsoever; and (2) a 400T that outproduced the old 16 oz. REED it replaced as well as competitive 16 and 20 oz. machines by as much as 30% on a 52-cavity mold for small model cars.

It costs you nothing to find how much you can gain by investing in new REED equipment. Your Reed-Prentice Sales Engineer will be glad to arrange a free mold demonstration test, or to make a production survey which will show how new machines can boost your present output. Call him today, or write to our main office in Worcester.

REED-PRENTICE

Affiliate of PACKAGE MACHINERY COMPANY

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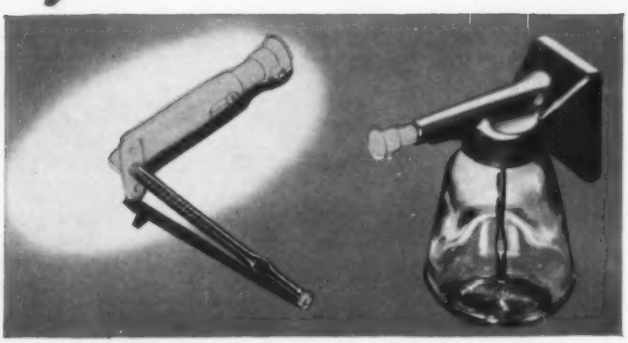
6 more examples

Tough, resilient skate wheels molded of ZYTEL readily bear the shock of romping feet and friction with sidewalks. One of the lightest of plastics, ZYTEL makes for featherweight designs of high strength. ("Zippees" roller skates by Manning Mfg. Corp., Chicago, Illinois.)



Valve assembly made of ZYTEL nylon resin delivers a measured amount of liquid soap at each stroke. It is unaffected by strong soap solutions and weighs much less than the stainless steel it replaced. (Manufactured by American Dispenser Co., Inc., New York, New York.)

Seven-transistor pocket radio has a virtually unbreakable casing of ZYTEL nylon resin. The smooth, gleaming finish of ZYTEL provides special sales appeal. (Manufactured by Zenith Radio Corporation, Chicago; case molded by Plastic Molded Products Co., Chicago, Illinois.)

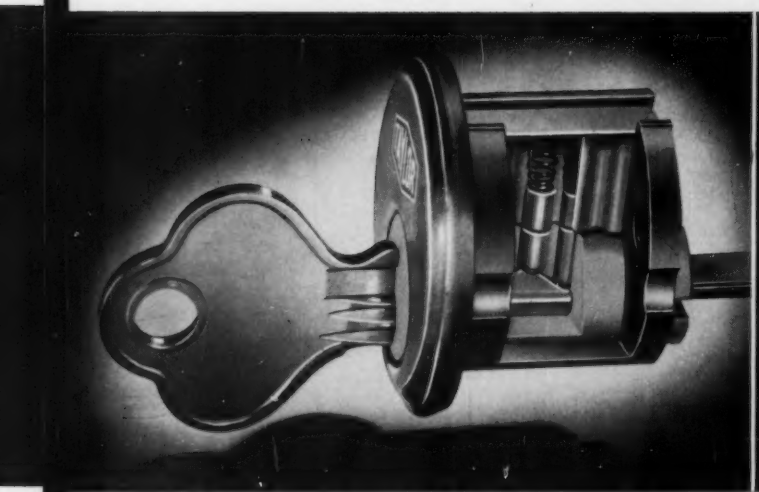
STRENGTH AND DURABILITY—these properties are the key to the rapidly expanding use of Du Pont ZYTEL nylon resin in consumer and industrial products.

For example, nylon has the highest strength-to-weight ratio of all the plastics. You can have the advantage of very light weight (sp.gr.1.14) and still put toughness into component parts. ZYTEL is hard, and extremely abrasion-resistant, often outperforming metals. Both gears and sleeve bearings of ZYTEL, tested in the presence of abrasive materials such as sand, have outworn metal components. ZYTEL is a resilient material with exceptional resistance to blows and shocks. Its hard, smooth surface forms a low-frictional contact area, so that mechanical parts need little or no lubrication.

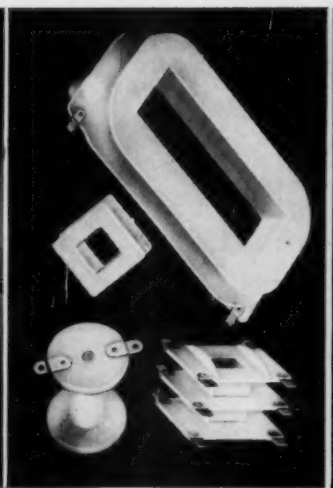
While most thermoplastics lose their rigidity when heat to 200°F. or more is applied, ZYTEL nylon resin is rated for continuous use

showing how Du Pont ZYTEL®
NYLON RESIN

makes new products possible ...existing products better



The cylinder plug of ZYTEL nylon resin in this door lock will never rust, and will assure long service life. Due to the low surface friction of Du Pont ZYTEL, the cylinder turns smoothly, will not stick and never needs oiling. (Made by the Taylor Lock Company, Philadelphia, Penna.)



Metallic inserts are molded directly into these strong, thin-walled electrical coil forms of ZYTEL. (Made by Hydro Molding Co., Plattsburg, N. Y.)

Now, aerosol bottles can be made in unique shapes and attractive colors. Using new ZYTEL 42, they are produced by blow molding or by welding matched sections . . . are so tough they bounce when dropped.

well beyond the boiling point of water, to 250°F. Heat-stabilized grades make continuous operation possible at this high temperature. Injection molding of ZYTEL permits high production rates, extremely accurate dimensions and a fine finish as molded. Intricate parts can be produced in a single shot. Even parts with thin walls are very strong when molded of ZYTEL.

Re-examine the materials you use in your designs in the light of the growing trend to ZYTEL. Let us show you more examples of product successes that have made this trend inevitable. Engineering data on Du Pont ZYTEL nylon resin is available. Ask for it.

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Polychemicals Department
Room 1910, Du Pont Building, Wilmington 98, Del.

Please send me more information on Du Pont ZYTEL nylon resin.
I am interested in evaluating this material for _____

_____

Name _____
Position _____
Firm Name _____
Street Address _____
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Type of Business _____

In Canada: Du Pont Company of Canada (1956) Limited, P.O. Box 660, Montreal

Controlled uniformity and great strength

Reinforce with a fiber glass fabric that allows you to design "strength where you need it" in your plastic products. UNIFAB gives you top strength per pound of reinforcement because of its controlled weave—weight uniformity—uniform thickness . . . checked and double checked to Ferro high-quality standards at every stage of production.

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Check FERRO first . . . for your complete fiber glass needs!

NEW METHOD FOR TREATING FILM FOR PRINTING PATENTED IN U.S.

Hit or Miss Methods Obsolete

LODI, New Jersey, Sept. 1—The United States Government has granted patent number 2,802,085 to the Modern Plastic Machinery Corporation of Lodi, New Jersey, covering their revolutionary electro-contact method of surface treating polyethylene and other plastic films rendering them receptive to printing inks, it was announced today. Additional U. S. patent applications for further improvements are still pending.

The MPM-Rothacker Film Treater, as the apparatus is called, has already been patented in Argentina, Belgium, Greece, Israel, Italy, Union of South Africa, Turkey, Peru, and France and applications are pending in 25 other foreign countries.

USE OF APPARATUS NOW BEING LICENSED

Some licenses have already been arranged for and many others are currently being negotiated because the plastic industry has become aware of the marked efficiency of the new MPM-Rothacker method which makes other methods obsolete. Royalty requirements and initial costs are moderate.

WHAT IS THE MPM-ROTHACKER METHOD?

This new method—a radical departure from existing ones—is an ingenious application of electronic principles. Film is passed between two distinct sets of rollers—one large roller and a series of smaller covered rollers. One set carries a positive electrical charge and the other a negative charge. Since the material is in direct contact with the rollers at all times, current merely has to pass through the thickness of the material being treated from one set of rollers to the other. The advantage of this revolutionary technique is obvious—no arcing takes place because high voltages are not required. Consequently, there is no corona discharge or formation of explosive or obnoxious gases. One simple control is provided as well as visual indicators so that the treatment is always **uniform, maintainable** and, with like settings, **reproducible** at any time with the same material. This applies not only to single layers but also to gusseted or folded material **irrespective of the intensity or velocity of the treatment.**

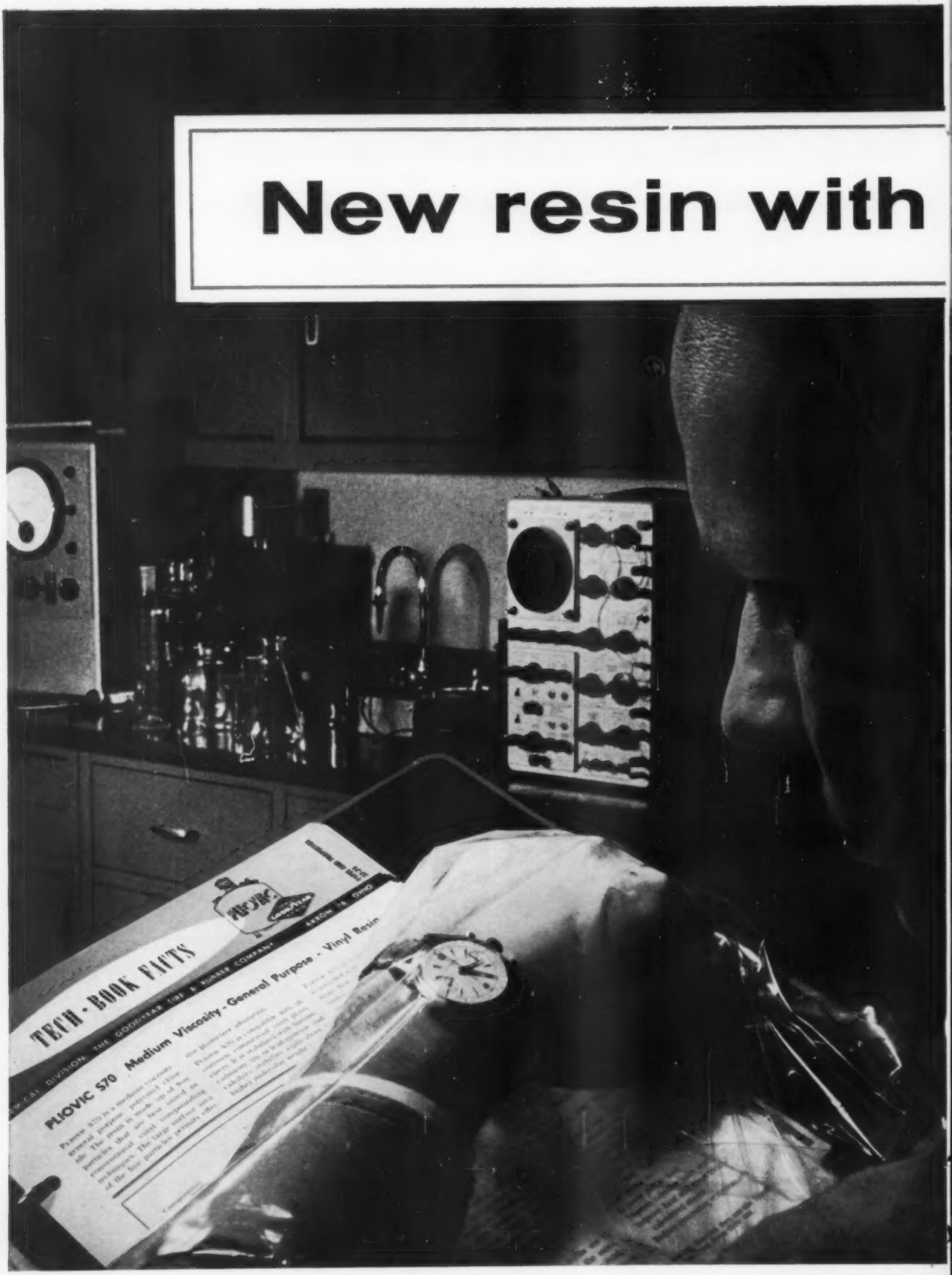
IMPORTANT ADVANTAGES OVER OTHER METHODS

- Certainty of treatment over entire film surface.
- Treating level dial indicator.
- Treats efficiently any known polyethylene formulation—slip or anti-static additives notwithstanding, as well as polytetrafluorethylene and polyethylene terephthalate.
- Treats right off the extruder.
- Speed of treatment many times greater than flame or older methods of electronic treatment.
- Variable control "tuned" to the requirements of the film being treated. For the same compound and thickness merely reset at the same setting for perfect results. No "hit or miss" or "trial and error" adjustments.
- Whether you use one MPM-ROTHACKER treater or a dozen, the same settings on any or all of them will produce identical results.
- Treats lay flat and gusseted tubing with equal efficiency and without damage at the folds regardless of the intensity of the treatment or speed of the material passing through the rolls.
- No special ventilation or fire hazard problems.
- No open flame or sparks to ignite chemical fumes or generate harmful or obnoxious gases.
- Electrical energy used is negligible.
- Uses standard, moderately priced electronic tubes, having average life of two years and usually guaranteed by tube manufacturer for one year.
- Spliced material will not interrupt continuous operation or require new settings or adjustment.
- Proven trouble-free after hundreds of thousands of pounds of film treatment.

Modern Plastic Machinery Corporation can make this statement, "If you can change a tube in a television or radio set, the MPM-ROTHACKER Treating Unit can be operated efficiently and over extended periods of time without costly interruption.

For further information, please write to Modern Plastic Machinery Corporation, 15 Union Street, Lodi, New Jersey.

New resin with



clear advantages

From the photograph at left, it is readily evident that sparkling clarity is one of the advantages offered by PLIOVIC S70. But once you've tried this newest of the custom-made vinyl resins by Goodyear, you'll find several other major benefits in its use, particularly in calendering applications.

PLIOVIC S70 is a medium viscosity, polyvinyl chloride resin. Its fine, uniform particles permit an ease of compounding which includes effective incorporation of all commercial plasticizers and stabilization with barium-cadmium, tin or lead systems equivalent to that obtained in higher molecular weight polymers.

The medium viscosity of PLIOVIC S70 also permits improved plastic flow and generally improved processing at *moderate* temperatures. In calendered goods, these processing advantages result in the following end-product improvements: 1. Excellent surface 2. Good gauge uniformity 3. Improved color uniformity 4. Good lay flat 5. Excellent heat sealability.

In addition to calendered goods, versatile PLIOVIC S70 can also be used to advantage in critical molded and extruded applications. Moreover, it offers an excellent means of modifying or "tempering" high modulus stocks for greater utility of equipment and production of a wider range of products.

Why not learn more about the clear advantages of PLIOVIC S70 and how they may solve your critical processing problems? The way to do it—and to learn more about the established members of the PLIOVIC family plus newcomers in the offing—is to write for full details, including the latest *Tech Book Bulletins*, to: Goodyear, Chemical Division, Akron 16, Ohio.

PLASTICS DEPARTMENT

CHEMICAL GOODYEAR DIVISION

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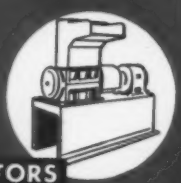
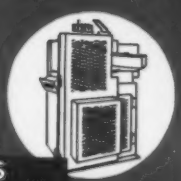
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

Chemigum, Pliofiex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

In Plastics Reducing Machinery, Look to CUMBERLAND for the COMPLETE LINE



GRANULATORS



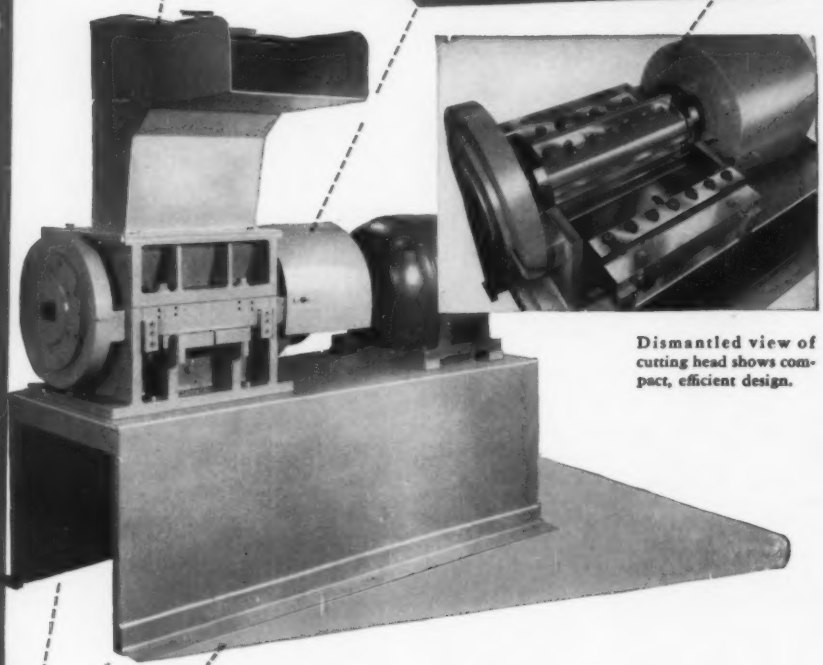
DICERS

CHOPPERS

PREBREAKERS

MODEL 20 All Steel Granulator

CUSTOM ENGINEERED
QUALITY BUILT



Dismantled view of cutting head shows compact, efficient design.

1 HEAVY DUTY — Large flywheel—thick all-steel weldments—deep welds—parts are of flawless wrought steel (not steel castings)—machine resists wreckage.

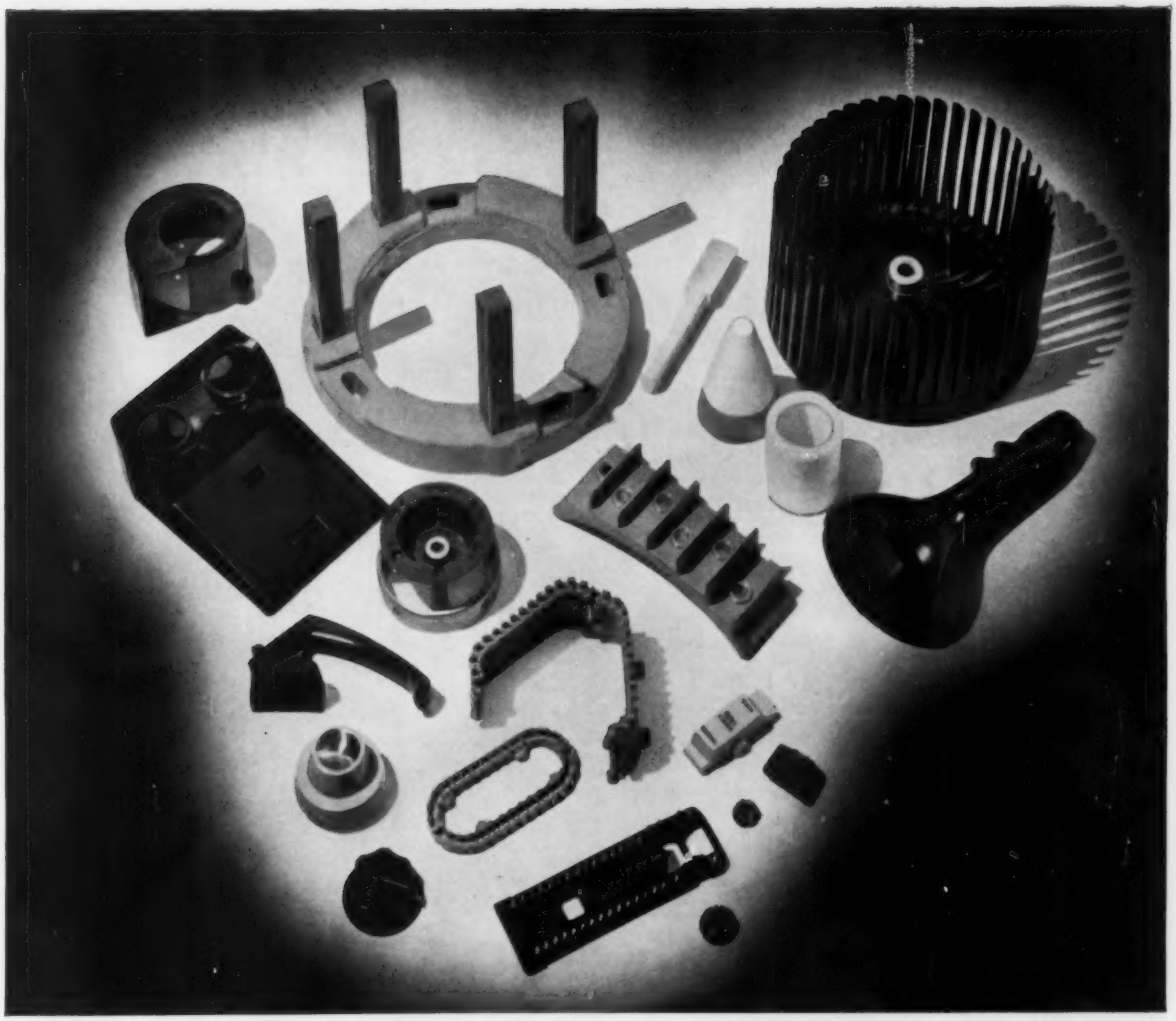
2 LARGE THROAT OPENING — 8 by 20″ size.

3 PRIOR BANDSAWING NOT NEEDED — Machine specially built to handle large chunky parts such as bleeder scrap, cylinder purgings and heavy cast slabs of polystyrene, modified polystyrene and acrylic resins.

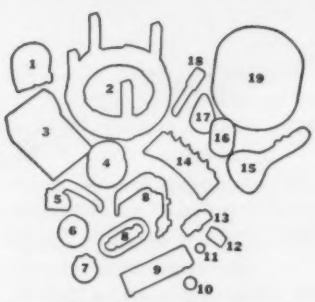
CUMBERLAND Engineering Company

BUILDERS OF BETTER MACHINES FOR THE PLASTICS INDUSTRY

RHODE ISLAND



prime source for molded parts



1. impeller housing. **2.** rocker ring. **3.** stereo viewer. **4.** fuse nose. **5.** appliance handle. **6.** and **7.** knobs. **8.** and **9.** terminal boards. **10.**, **11.**, and **12.** miniaturized parts. **13.** organ key. **14.** terminal board. **15.** spinning reel handle. **16.** valve liner. **17.** fuse nose. **18.** organ key. **19.** blower wheel.

For three good reasons, Kurz-Kasch is a prime source for molded thermosetting plastic parts. *First: money-saving experience.* The parts shown illustrate our breadth of experience and capacity for handling difficult jobs. *Second: money-saving tooling.* We design tools and dies for best long-run production economy. *Third: money-saving deliveries.* You get believable promise dates and your parts arrive on schedule. Call your nearest representative for a quote on your next job. Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio.

kurz-kasch

SPECIALISTS IN **THERMOSETTING PLASTIC PARTS** FOR 41 YEARS

New York, Mt. Vernon, Mo 4-4866; Rochester, Hillside 0626; Beverly, Mass., Walker 2-0065; Chicago, Gladstone 6-8837; Detroit, Jordan 6-0743; Atlanta, Cedar 7-5516; Philadelphia, Hilltop 6-6472; Minneapolis, Walnut 6-2749; Dallas, Lakeside 6-5233; Pasadena, Ryan 1-6774; St. Louis, Parkview 5-9577; Toronto, Oliver 7986

with ESCAMBIA PVC

Photomicrographs* of production samples of leading PVC resins show that Escambia PVC resins are extremely low in fines and have superior uniformity of particle size.

Besides eliminating "dust storms" in your plant, these qualities in Escambia PVC give you freer-flowing hot pre-mixes, lower "fish eye" count, better heat stability, and improved color uniformity and clarity.

Prove these unique advantages in your own plant with a test run of Escambia PVC resin best suited for your operation:

ESCAMBIA PVC 1250 — High molecular weight recommended for extrusion and calendered film.

ESCAMBIA PVC 1225 — Intermediate molecular weight and particularly adapted for supported and unsupported sheeting.

ESCAMBIA PVC 1200 — Recommended for applications in which processing temperatures require the use of a lower molecular weight resin than PVC 1225.

*In the photomicrographs shown above, the resins have been magnified 40 times.

For additional information about Escambia's straight PVC resins — write or call —

ESCAMBIA CHEMICAL CORPORATION

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BOPP

Why not a truly modern Reifenhäuser-Extruder from the start . . . ?

. . . . . not only extruders are modern and automatic in operation, but also take-off units and auxiliary equipment. All offer high hourly output and a first-class product plus dependable performance.

For these reasons REIFENHÄUSER installations assure profitable operations at all times.

The extruder illustrated above has a screw of 3½" diameter. Equipped with proper take-off units it will produce all types of cable coverings, film, piping, tubing, sheeting, blown films, profiles, etc. In addition to the 3½" extruder, REIFENHÄUSER builds extruders with 1¼", 2½" and 6" diameter screws.

Why not entrust REIFENHÄUSER with your problems in extruding thermoplastic materials.

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Canada:	Transocean Machine Company Inc. 267 Dunbar Avenue, Montreal 16, P.Q.
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South-Africa:	Optimum Agencies Ltd. Cape Times Building, St. George's Street, Cape Town
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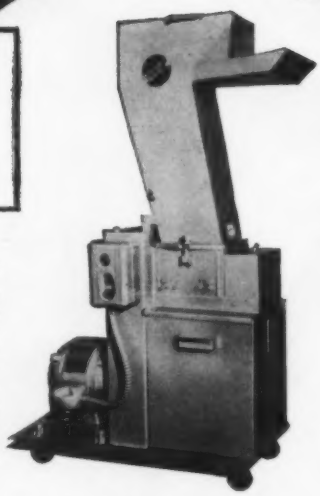
INJECTION MOLDERS!

BOOST PRODUCTION!

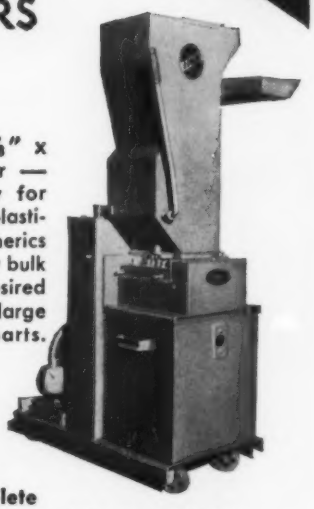
M-3 IMS M-4 GRANULATORS

All machines illustrated here in stock for prompt delivery.



The IMS M-3 6½" x 7" throat sprue grinder — rugged — simple in design — easiest to clean — built-in throat clearance bar — casters — catch pan.

PRICE: Complete with 1 HP Motor and Starter $598.50



The IMS M-4 5⅜" x 8½" throat grinder — designed primarily for vinyl, polyethylene, plastisols and all elastomerics where a fine-free low bulk factor product is desired — large throat for large injection molded parts.

PRICE: Complete with 2 HP Motor and Starter $788.50
Same, but with 3 HP Motor $854.00

CONSTANT MOLD TEMPERATURE REGULATOR

The IMS Economy Circulator — **priced at only $369.50 complete (oil model for heats to 450° at $482.50)** — duplicates performance of mold heaters costing up to 6 times as much — developed by a molder for molders — compact — portable only 15" x 22½" floor space.

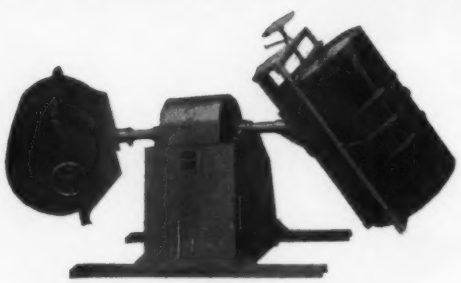
NOTE: Special price for 2 units ..... $349.50 Each

Send for our 1957 Nozzle Catalog and Heater Band Book Today. You'll find all styles of nozzles and heater bands fully described and priced, with technical notes on nylon molding.

Prompt service on all kinds of nozzles by the world's largest and most experienced nozzle specialists.

IMS DRUM TUMBLERS

FOR ALL COLORING AND MIXING OPERATIONS



All IMS Drum Tumblers are based on design suggestions of the leading material and colorant suppliers. Available for immediate shipment from stock.

¾ HP Model $595.00
(Takes drums up to 33" high x 22" in diam.)
2 HP Model $897.50
(Takes drums up to 37" high x 23¼" in diam.)
3 HP Model $1285.00
(Takes drums up to 45" high x 24" in diam.)

INJECTION MOLDERS SUPPLY CO.

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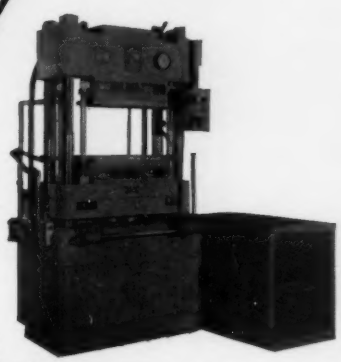
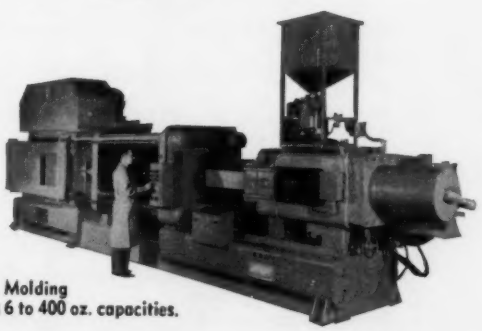
HPM

80 YEARS BUILDING A TRADITION

Unlike many anniversaries that are built to exaggerated proportions, H-P-M is entering its eighty-first year with a minimum of interest in the past. Instead our research and development have geared our efforts to a program for the future. We like to feel that throughout our long and varied experience we have learned to anticipate the needs of the many industries with which we work. It is their future that guides our planning and our policies for the days ahead. This thinking has traditionally guided H-P-M to its present position as a leader in the hydraulic industry. Our goals will be changed only to provide more and better service to the industries we serve.



H-P-M Compression and Transfer Molding Presses 100 to 500 ton capacities, up to 2500 tons on special order.



Plastic Injection Molding Machines 6 to 400 oz. capacities.

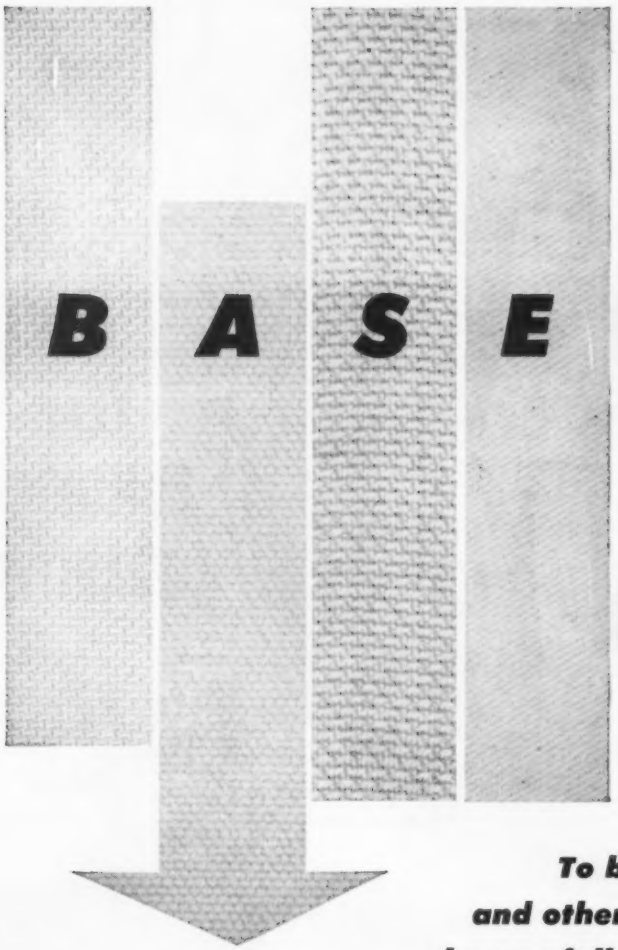
HPM

THE HYDRAULIC PRESS MFG. CO.

Mount Gilead, Ohio, U.S.A.

A DIVISION OF KOEHRING COMPANY

1877—1957



a BASE fabric's work is only as good as its bond!

To bond well with plastic, rubber and other materials, base fabrics must be carefully selected for the specific job

The success of end products made through the coating, laminating, combining or frictioning of a fabric often depends on how well that base fabric bonds or unites with the vinyl, neoprene, natural rubber, phenolic resins, etc.

At Wellington Sears, many factors are considered in choosing a base fabric. These are related to the job to be done, and the materials to be united with the fabric. Some are: fiber affinity for these materials; form in which fiber and yarn are used; effect of yarn twist, thread count, fabric sizing, and special fabric treatments. Further, the base fabric must meet requirements as to flexibility, strength, weight and other characteristics before it gets a final okay. With such care (and a century of experience) working for you, you're in good hands whenever you take your working-fabric problems to Wellington Sears! For informative booklet, "Fabrics Plus," write Dept. K-10.

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The trail is well-marked

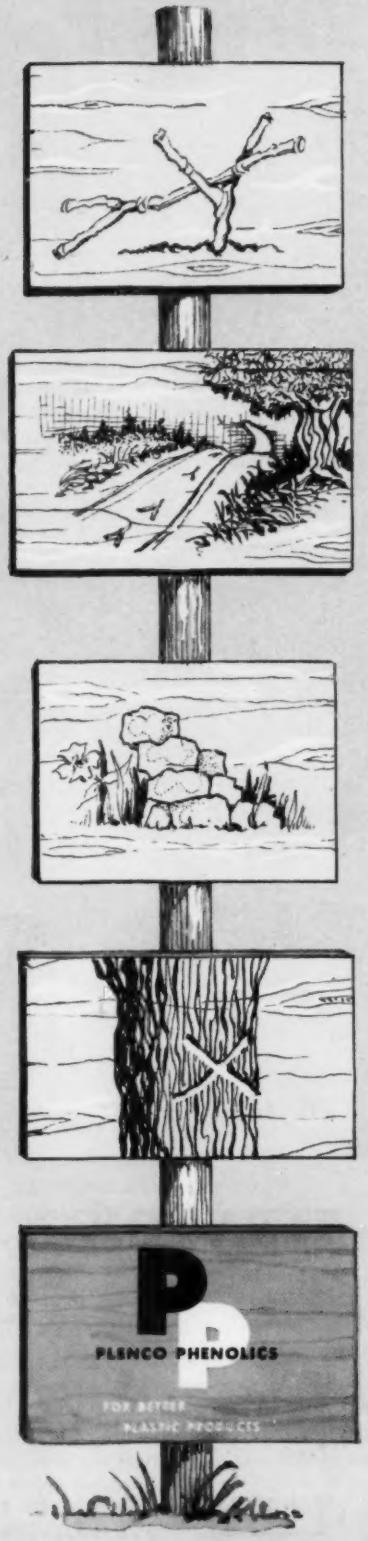
for alert designers

and manufacturers

who seek the help

of quality phenolic

molding compounds



PLENCO

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of
high grade phenolic molding compounds, industrial resins and coating resins.

TITANOX*... the "sole of whiteness"

She's a light-footed young lady, because the white rubber in her shoes is pigmented with TITANOX titanium dioxide white pigments.

Your best foot is forward, too, when you choose TITANOX pigments for whitening, brightening and opacifying rubber and plastic compositions. Not only do you get high brightness, but you also get formulating bonuses in ease of milling, in thorough dispersion of the pigment, and in the relatively low loadings needed. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y. Offices in principal cities.

TITANIUM PIGMENT CORPORATION

Subsidiary of **NATIONAL LEAD COMPANY**

*TITANOX is a registered trade mark for the full line of titanium pigments offered by Titanium Pigment Corporation. 5209

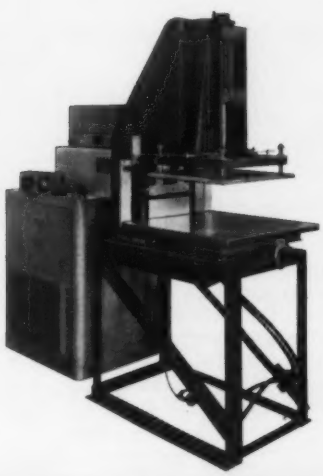
Adds a new dimension to plastic fabrication

with the NEW

Thermatron COLORSEAL Die Hotplate

...easily attached to any Thermatron press

Now you can enrich the look of your welded plastic products with additional colors – two or three if you wish – using any standard Thermatron press. The special new Colorseal Die Hotplate handles bright, multicolor appliqués in one simple operation, adding more variety and eye-appeal in a matter of seconds.



Colorseal is interchangeable with the upper platen of your press and can be used with all die designs by merely throwing a switch. It welds and trims simultaneously, creating colorful borders, overall patterns, monograms, emblems, etc. For more information, write today to Section 116.

- Made of thick steel, annealed and surface ground for flatness and rigidity.
- Electroplated to prevent rust and corrosion.
- Thermostat control for close temperature regulation.
- Accurate temperature indicator and uniform heat distribution over entire surface.
- Easily replaced cartridge heaters.
- Filtered to prevent harmful R.F. feed-back into power lines.
- High power for rapid warm-up.
- On-Off control switch.
- Asbestos-insulated wiring for long life.
- Maintains original daylight dimension on press.

Thermatron

Radio and Electronic Products Since 1922

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RADIO RECEPTOR COMPANY, INC.

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says . . .

"NRM *Thermoplastics* EXTRUDERS

MORE THAN MEET OUR RIGID REQUIREMENTS for ACCURACY . . . ECONOMY . . . LONG LIFE"

Sixteen years ago Anchor Plastics Company of Long Island City, New York, started producing custom extrusions in a small building, with one NRM Extruder. Today the company occupies a modern, 40,000 sq. ft. plant and operates 15 extruders—all NRM. This photo shows Anchor workmen "setting up" a 3½" NRM Extruder.

When we asked Anchor officials the reasons for the company's success, they replied: "Undoubtedly our policy of fast service on top quality, precision extrusions is the biggest factor. We have preferred NRM Extruders all these years because their ability to do close-tolerance work economically, has enabled us to set high standards and maintain them."

"They have a long, productive life too," added Mr. Fisch, President, "why, our very first NRM is still producing profitably after sixteen years of continual service."

NRM's accuracy, economy and long productive life are just a few of the *many* reasons why leading custom extruders like Anchor Plastics Company standardize on NRM. Without obligation we'll send you data and details on the NRM *full* line of Plastics Extruders and Equipment. Compare their advantages with any other extrusion machine, and you, too, will *standardize* on NRM. Write today.

2012

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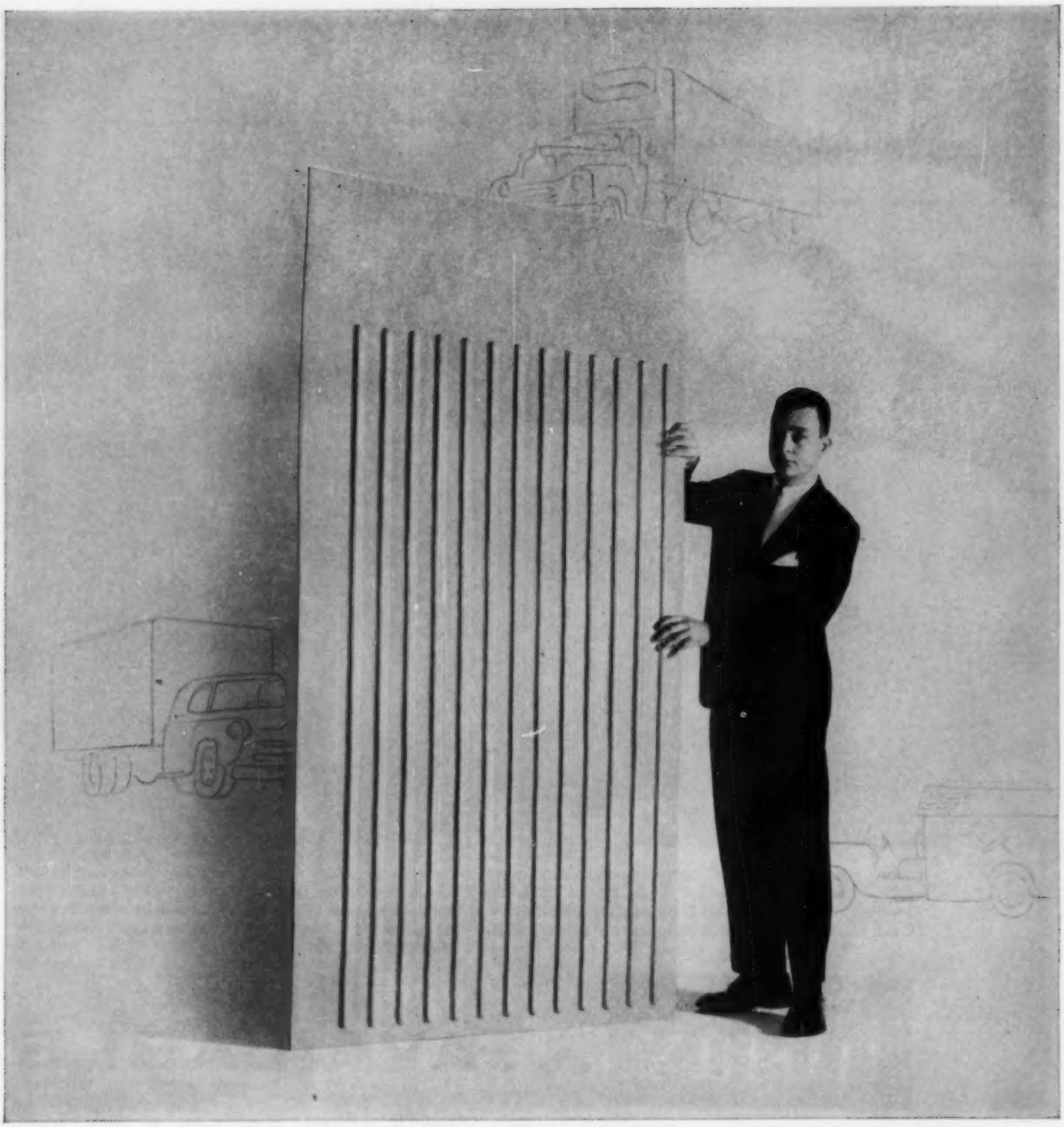
MID-WEST: National Rubber Machinery Company, 5875 N. Lincoln Ave., Chicago 45, Ill.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.



TRUCK BODY AND TRAILER MANUFACTURERS CHOOSE ROYALITE...for damage-free paneling of refrigerated units

After thorough testing, several of the largest truck body and trailer manufacturers found that nothing measures up to U. S. Royalite paneling for refrigerated units. Royalite (the industry's standard for A.B.S.* plastics) is extremely light, yet so durable it withstands everyday abuse. Keeps its toughness even at very low temperatures. Is acid-resistant . . . completely sanitary . . . easy to clean. Production men have found great economies in assembly costs by using Royalite panels. Find out how U. S. Royalite can benefit *your* product. Write for information.

**acrylonitrile, butadiene and styrene*

US RUBBER Royalite® NITRILE THERMOPLASTIC SHEET

US RUBBER **United States Rubber**

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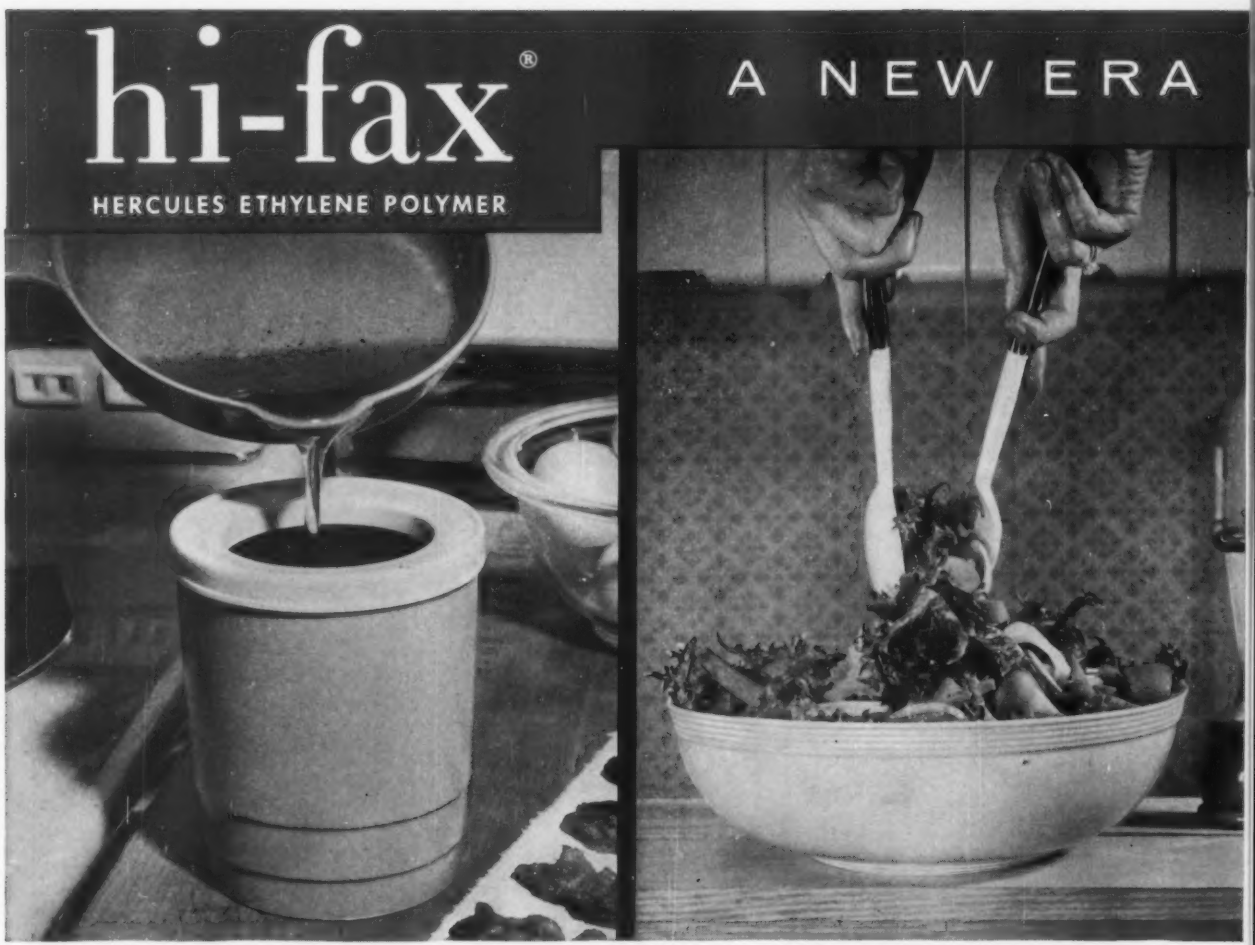


Unique new "Grease Kup" and large salad bowl were among first products molded with Hi-fax to reach American consumer market. In these uses, resistance of Hi-fax to household greases and solvents is important. Light weight, durability, and rigidity were other factors prompting its selection. Products each come in three attractive pastel colors, are advertised by manufacturer as "boilproof." *Molded and manufactured by Plastray Corporation, Detroit, Michigan.*

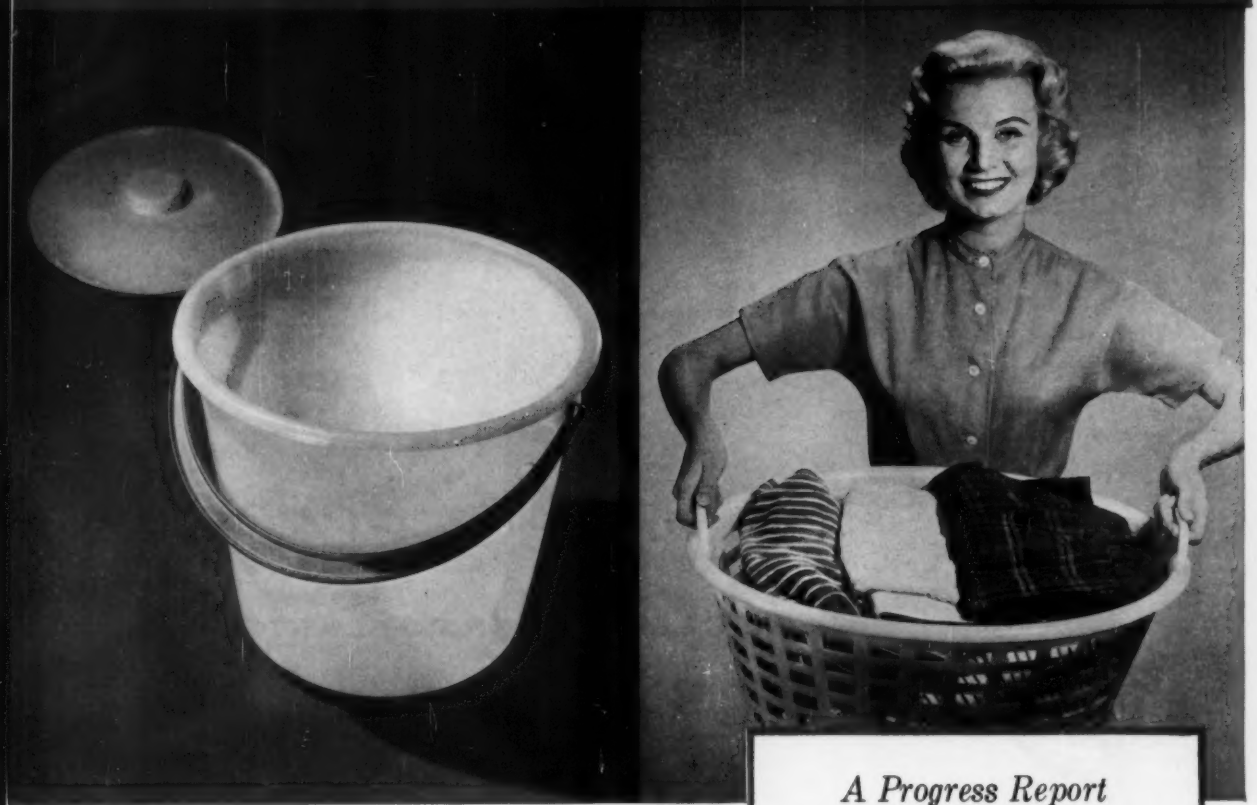
hi-fax® . . . AVAILABLE FOR SUPERIOR

Colorful and durable plastic housewares that won't break or shatter and can withstand exposures in modern automatic dishwashers are now a reality, thanks to Hi-fax. Its advent ushers in a new era in housewares, greatly enlarging the range of usefulness of plastics in a field where consumers familiar with the plus qualities of plastics will readily accept improvements or additions to product lines.

Hi-fax has already been broadly evaluated in housewares, and manufacturers are now geared to convert many existing items to this versatile material for immediate distribution. They are also taking advantage of the properties afforded by Hi-fax to design new merchandise to round out their product listings. Hi-fax promises to find ready use by housewares producers, both as a replacement for plastics previously employed and as an improved material in other spots where before no plastic could qualify.

As compared with conventional polyethylene, Hi-fax is a higher density material, having greater rigidity, heat resistance that permits

IN PLASTICS CHEMISTRY



Hi-fax is a "natural" for large-unit moldings; yields lightweight parts since excessive wall thicknesses are not required to obtain desired degree of rigidity. Richly colorful covered pail and large clothesbasket are both molded with Hercules' new ethylene polymer. Tough, durable, and with a permanently lustrous finish, they won't shatter, rust, or corrode.

A Progress Report from America's First Ziegler Polyethylene Plant

IN QUANTITY HOUSEWARES

sterilization, and better surface and color range.

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CP57-4

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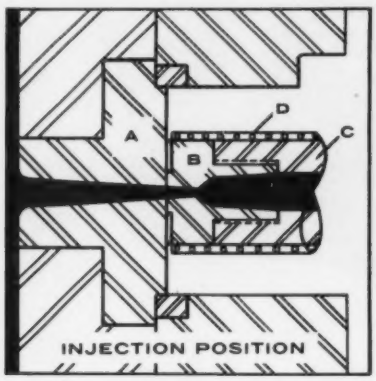
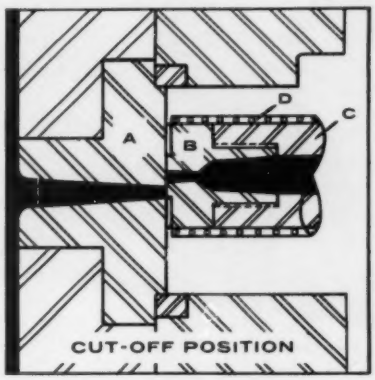
Three tough jobs show why you get better * nylon parts from Lesters

THE CLUE IS IN THE SPRUE



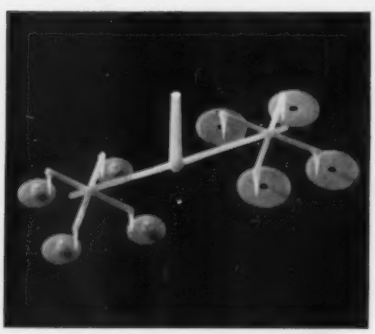


A—SPRUE BUSHING
B—FLAT NOZZLE
C—NOZZLE EXTENSION
D—NOZZLE HEATER

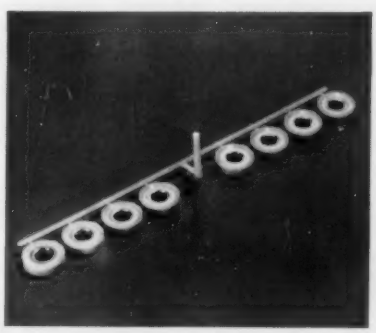
Look at the sprue on any of these nylon shots...it is clean and sharp, with no "string" or lamination or other evidence of frozen material. You *know* it was molded on Lester Injection Molding Machines. The sketch above shows why.

MECHANICAL SHUTOFF

On all Lester machines which mold nylon, the exclusive cut-off attachment allows free flow of the material in the injection position. However, before the mold opens, by the simple device of lifting the flat nozzle out of register with the sprue bushing, the material is effectively cut off, providing a clean, sharp sprue, and at the same time holding the molten material ready for the next shot in a heated zone until the instant of injection.



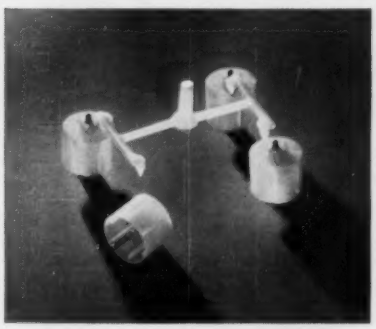
Conventional molding machines make use of a reverse taper in the sprue bushing, a baffle in the nozzle, or other such device to restrict the rate of drool. In the Lester *there just is no drool!* The quality of the material delivered to the cavity is not diminished by exposure to a cold sprue bushing or restrictions in the nozzle area.



Likewise, on conventional machines, a great premium is placed on the skill of the operator in removing parts from the machine at a precisely constant rate so that there is no drool into the parting line. He must also be skilled enough to pick "strings" that may have resulted from previous shots.

MOLD AND PART DESIGN

The nylon parts illustrated here, like many others, would spell "trouble" without the Lester cut-off attachment. Notice the variety in both mold and part design: 3-plate molds, pin-point gates, thin wall sections, metal inserts, heavy section—and they are all routine injection jobs on Lester machines.



BETTER PARTS

Thus the combination of the Lester cut-off attachment with the Lester internally heated cylinder and four-zone pyrometer control (for perfectly plasticized material) assures the molder that he will produce nylon parts that are :

* 1. more resilient
2. more dense
3. whiter

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2. less-skilled operators
3. less waste

Write for complete specifications on Lester machines, ranging in capacity from 4 to 60 ounces.

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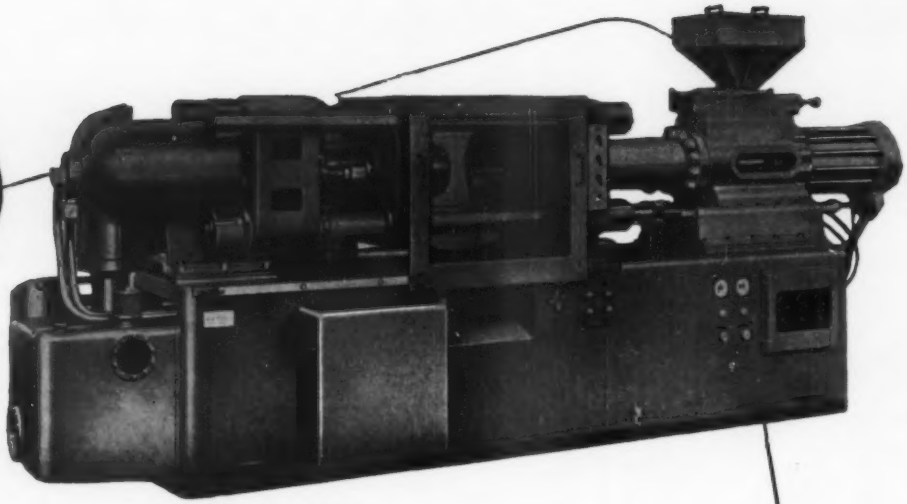

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Negri Bossi injection presses feature maximum serviceability—cylinder, screw, nozzle, and heaters can be removed as units by just one person. Main components are interchangeable. All machines are equipped with oildynamic power drive unit and a special safety device. Model NB 360/520, 12 to 19 oz. capacity shown above.

"Rapid" Fully Automatic Injection Presses
Another example of Negri Bossi progress in automation, the "Rapid" series provides fully automatic, rapid-cycling operation. Models available with 1, 2, 4, 6 oz. capacities.

Extruders
Negri Bossi single screw extruders are available in the "Standard" series with 1 3/16, 1 7/8, 2 3/8 screw diameters, and the "TV" series of variable-speed models with 1 7/8, 2 3/8, 2 3/4, 3 1/2 inch diameters. Screw and die heads are available in a variety of designs for such applications as tubing, profiles, wire coating, monofilaments, and for extruding and blowing PVC and polyethylene tubular films.

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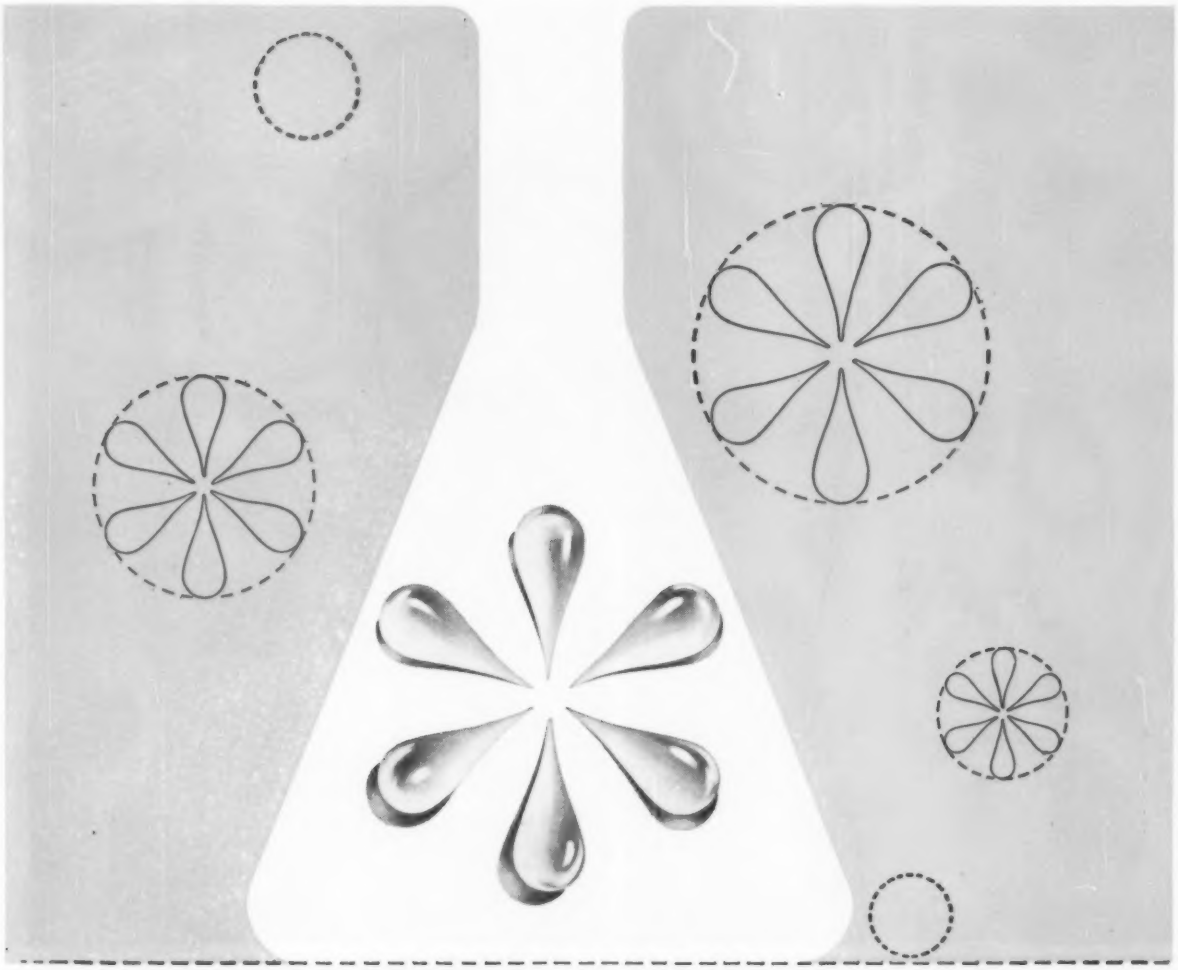

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SHELL

The Plastiscope*

October 1957

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Polypropylene on the way. Don't bet that isotactic polypropylene molding material won't be available on a small commercial scale for the American market before the end of this year. The individuals involved are cautious but confident. Here are some of the advantages being advanced in its favor:

It can be molded easily in the same molds now used for conventional polyethylene—even the largest. It is claimed to have a 10% higher heat resistance than high-density polyethylene, with a harder surface and a better gloss. Moldings are less susceptible to molded-in stresses than is polyethylene and they don't warp. The material can be formulated for good electrical properties. Another advantage for producers is that propylene monomer can be shipped in tank cars: ethylene must be moved under pressure in pipes.

Regular polymerized polypropylene has been known in the laboratory for years but is not isotactic and is not highly crystalline, according to some chemists. It has been blended experimentally with low-density polyethylene to attain softness, especially for better flow and improved film qualities. But isotactic polypropylene is not soft and, because it has the hardness and toughness necessary for good molding, there is no reason for blending. Also of interest is the fact that isotactic polypropylene can be produced by Ziegler as well as by Natta chemistry.

Price could be higher on a pound basis than many thermoplastics, but molders can use less per piece because of its stiffness and moldability. Its properties suggest that it may be used for many items now molded in nylon as well as other thermoplastics. Specific gravity is about 0.90 compared to around 0.920 for most conventional low-density polyethylene, around 1.05 for polystyrene, and about 1.14 for nylon molding material. Because of this great weight advantage producers may charge a higher price per pound, but its higher yield per pound could make it competitive with lower priced polymers for many applications.

This information is in no sense related to a European rumor that Montecatini has taken an option on a parcel of ground in U.S. adjacent to a Cities Service plant that might be expected to supply ethylene or propylene.

Delrin looks like bright, new starlet. Du Pont is expected to announce construction of a plant to produce Delrin acetal resin on a commercial scale in the very near future. It should be ready about 1959 or 1960. There may be some delay before an official announcement is made, but it seems incredible to believe that the company would ever abandon its plans for this promising new resin. Pilot plant quantities in sufficient amounts to produce numerous moldings have been available for a year or so and the more it is used the more glamorous this new material appears.

*Reg. U.S. Pat. Off.

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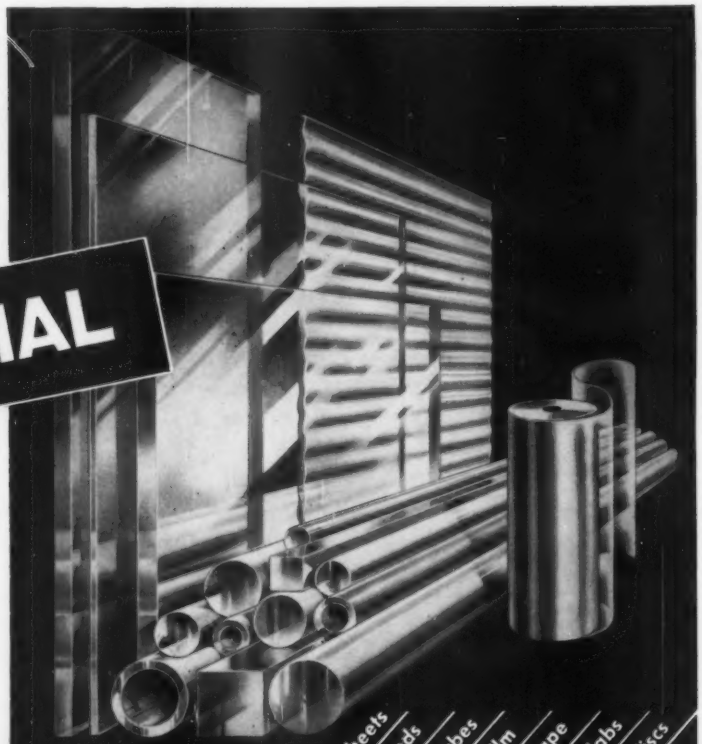

	sheets	rods	tubes	film	tape	slabs	discs	
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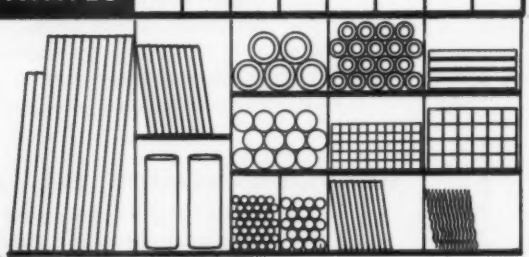
NYLON	√	√	√	√	√	√	√	
TEFLON	√	√	√	√	√	√		
VINYLITE	√	√	√					
ACETATE	√	√	√	√				
POLYSTYRENE	√	√	√			√	√	
POLYETHYLENE	√	√	√	√		√		
PHENOLIC LAMINATES	√	√	√					



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The Plastiscope

(*Continued from page* 35)

Among outstanding characteristics of Delrin are its good load-bearing properties at temperatures of 150° F. or more. Du Pont lists it as a companion piece to nylon, but many observers think it will eventually become a much greater-volume material. The introductory price will likely be around $1.00/lb. with a quick drop to less than 80¢ when it starts to move. Eventually it should drop much lower since the raw material from which it is derived, formaldehyde, sells for 10 or 11¢ a pound. See p. 284 for details.

Molded methacrylate monomer. The old idea that liquid monomer can't be molded has been at least partially disproved by Birckhead Corp., Baltimore, Md., which is producing a molded "egg crate" light diffuser from a mixture of methacrylate monomer and Du Pont's 51¢ methacrylate polymer. Since monomer is only 29¢/lb., every effort is made to keep the monomer content much higher than the polymer content.

The production operation is a cross between molding and casting—a sort of slurry casting—but Birckhead calls it molding; about 20-lb. pressure is used, with low heat in a grid-like aluminum mold. Aluminum is used because of its rapid heat conduction, because the molds are light in weight, and because they are considerably less costly than injection machine molds used for producing other thermoplastic light diffusers.

The shrinkage problem has been overcome by propagating tiny, almost invisible bubbles during the setting-up process, but a skin is formed on the finished product which prevents surface porosity and gives strength. Density of the finished product is about 1.0.

It is easy to see that Birckhead, by using a lower-cost material plus an inexpensive manufacturing method, is aiming at a market in the lighting field which is now dominated by other thermoplastics. It is also possible that this "monomer-molding" method may soon be adapted to production of other products, but the company is now concentrating on light diffusers because of methacrylate's exceptionally good weathering properties and its resistance to yellowing or deterioration by light rays.

Bakelite's new fast-curing phenolic. For several years all phenolic molding powder producers have been stepping up the cure time of their resins so that the molder could operate at greater speed. However, most of the increases have been only moderate. But now Bakelite has made the startling announcement that its new BMM-7000 Black 25 will make possible reductions in cure time of up to 50 percent.

The new material is a woodflour-filled, general-purpose, two-step resin and is particularly suitable for electrical components. A one-step resin is a simple phenol and formaldehyde formulation; a two-step resin has a hardener added to make it easier for the molder to handle, but ordinarily it takes longer to cure. The new BMM-7000 is significant because it has the easy handling characteristics of a two-step resin but even faster molding characteristics than a one-step resin. It is also harder as it comes out of the mold so that it can be removed quickly without deformation.

The new material was developed specifically for use in cold-powder automatic molding but may be used in most types of compression molding

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The Plastiscope

(*Continued from page 37*)

equipment. However, because of its low fines content, it can be preheated on standard equipment with preheating times about 40% less than for a fast one-step material and about 20% less than for a typical two-step material. It can be preheated over a wider range of preform temperatures than most other phenolics and still give complete fill-out of the mold, so consequently it is quite suitable for molding large pieces.

National Petro-Chemicals adds to polyethylene capacity. A new 75 million-lb.-per-year plant for production of medium-density (0.926 to 0.940) polyethylene will be in operation late in 1958 by National Petro, whose products are sold by U.S. Industrial Chemicals. The plant site will probably be in the Southwest. A modification of the high-pressure system will be used in the new installation. USI is a firm advocate of the theory that medium-density, high-pressure-processed polyethylene fits in snugly between low- and high-density polyethylene and that its properties of heat resistance, stiffness, permeability, etc. are high enough to meet most of the requirements for applications commonly associated with low-pressure-processed polyethylene. USI is the only polyethylene producer not committed to some form of low-pressure-processed polyethylene but has not absolutely closed the door to its production if the situation seems to call for a low-pressure plant.

The new 75 million-lb. plant, plus the 100 million-lb. plant at Tuscola, Ill., will make National the third largest polyethylene producer in the world. Bakelite will have well over 300 million lb. capacity when its new low-pressure plants come into operation this fall, with probably more to come. Du Pont will have an estimated capacity of more than 230 million when its new low-pressure plant is built.

USI officials also admit that plans for building a vinyl chloride plant are now definite, but site and capacity are unannounced.

Price reduction for Zytel nylon. Du Pont has reduced the price of Zytel resins by approximately 10 percent. Zytel 101, the general-purpose molding powder, has been reduced from $1.33 to $1.18/lb. in truckload quantities. Du Pont officials state that the number of truckload customers might surprise the uninformed. The price for 5000 lb. up to truckload quantities is now $1.20/lb.; smaller quantities range from $1.23 to $1.35. Extrusion grade is now $1.28.

The price of Zytel 101 was $1.60/lb. in the early 1950's. On April 1, 1955 it was reduced to $1.43½ and on Feb. 15, 1956 the price became $1.33. Officials refuse to speculate on future price reductions, but customers surmise that broadening markets and competition from other materials will bring the price down under a dollar before many years have elapsed.

It is significant that up to now the comparatively high price of nylon has not interfered seriously with growth since it was deliberately channeled into fields where price was less important than durability. Dome lights for autos and certain types of coil forms and bearings are examples. Since these markets are now well established, it is natural that other markets be developed in competition with other materials and a lower price will help capture them. Du Pont's new extrusion grade Zytel is also expected to help broaden the market, with blown bottles as the first notable example. An interesting

23 claims allowed!

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LONG ISLAND CITY 1, N. Y.

Patented July 21, 1953 — 2,646,380

UNITED STATES PATENT OFFICE

2,646,380

METHOD OF MOLDING THERMOSETTING SYNTHETIC RESIN MATERIALS

Alfred Charles Barlow, Parkway, Hillingdon, William George David Carpenter, Hayes, James Brisbane Cameron, Hounslow, and John Matthias Griffith, Isleworth, England, assignors to The Fairey Aviation Company Limited, Hayes, England

Application August 28, 1950, Serial No. 181,916
In Great Britain July 13, 1950

5 Claims. (Cl. 154—100)

1 2

This invention relates to an improved method ... thousandths of an inch, impregnating the deco-

United States Patent Office — 2,797,18 — Patented June 25, 19

1 2

2,797,180

METHOD OF MAKING ORNAMENTED BOWL-LIKE ARTICLE, AND ORNAMENTATION CARRIER THEREFOR

Nicholas T. Baldanza, Rutherford, N. J., assignor to Fairhaven Properties Corp., a corporation of Delaware

Application July 12, 1955, Serial No. 521,5

18 Claims. (Cl. 154—11

This invention relates ... has particular refere... surface of a mol... steep sides.

In the art ... molded pl... a trenchan... respect... first ... an...

pletion of the molding procedure, the ornamentation e... rier is supported in a positional relationship in which t... opening is in registry with the mouth of the article wh... the appendage is in a transverse position in overlyi... relation to the side surface to be ornamented.

The peninsular appendages are advantageously two ... more in number, and symmetrically arranged in diamet... cally opposed relationship, as will be pointed out he...

READ the fascinating story of "The Schlitztap"—a history making first in the industrial use of decorated melamine, in the September issue of Modern Plastics, or write in for a reprint.

MODERN PLASTICS

The Plastiscope

(*Continued from page* 39)

new development in Germany is a clear nylon film raincoat made from a mixture of nylon-6 and 6/6.

Impact methacrylate sheet. Westlake Plastics Co., Lenni Mills, Pa., is offering sheet of the new Rohm & Haas Implex impact methacrylate material in sizes that range up to 18 by 36 in. and in thicknesses up to 2 inches. The company also sells standard methacrylate sheet in quantities as small as one and in any color. Linear polyethylene rod will also be offered in the near future.

Linear polyethylene in sheet form. National Plastic Products Co., Odenton, Md., is now producing polyethylene sheeting from linear, or low-pressure-processed, polyethylene. The company claims it is suitable for vacuum forming and has rigidity as well as resistance to both heat and cold. The company also claims that its formulations have been accepted by the Federal Food and Drug Administration as satisfactory for use in food packaging. It is available in colors and is suggested for containers, housewares, refrigerators, etc.

National is also providing linear polyethylene fibers that are being tested for retention of color, weathering, and tautness—for use particularly for outdoor furniture—and is also now in bottle molding.

Expansion for emulsifiable polyethylene. Semet-Solvay Div. of Allied Chemical is expanding production facilities for emulsifiable A-C Polyethylene 629. The emulsifiable type is used primarily by the polish, textile, and paper industries. In polish it is particularly useful for imparting durability, gloss, and non-slip properties as well as water resistance. The most rapidly expanding application for 629 is for sizings in textiles where it imparts improved abrasion and soil resistance, smooth hand, fine drape, and better sewability.

Vinyl acetate monomer. Air Reduction Chemical Co. is expanding its vinyl acetate monomer plant at Calvert City, Ky., from 30 million to 45 million lb. per year. Vinyl acetate is the basic constituent for paint resin, adhesives, polyvinyl alcohol, and butyral, but recent growth as a water-based paint resin has probably attracted the most attention. Estimated amounts of solid resin for paint are 20 million lb. in 1956; 20 to 25 in 1957 and 1958; and 30 to 50 in 1959 and '60. Acrylic-resin-for-paint producers dispute these figures—say that acrylic paint will absorb even greater shares of the market.

Rubber-modified styrene for vacuum forming. Bakelite, which last month introduced a new variety of rubber-modified styrene for molding, now has one for vacuum forming. Designated TGD-6000, the new styrene has high rigidity that permits production of thinner refrigerator door liners, lessens the need for liner reinforcements, and reduces the possibility of liner cracks around metal fixtures. With the new resin, re-use of trim is possible if it is kept clean.

For additional and more detailed news see Section 2, starting on p. 284

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The rapid growth of the reinforced plastics industry has been due partly to the savings made possible by inexpensive mineral fillers. Prominent among the latter are the Hydrite Kaolinites which successfully replace expensive resin.

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1. **Polyester Resins**
2. **Chlorinated Polyester Resins**
3. **Epoxy Resins**
4. **Diallyl Phthalate Resins**
5. **Phenolic Resins**

The marked cost advantages in using Hydrite Kaolinite Fillers, together with the fact that they improve the quality of the reinforced plastic in several important respects, makes information regarding their use interesting to plastics producers.

The story is told in a new 20-page booklet which we will be glad to send you free of charge. Ask for our Bulletin 4.

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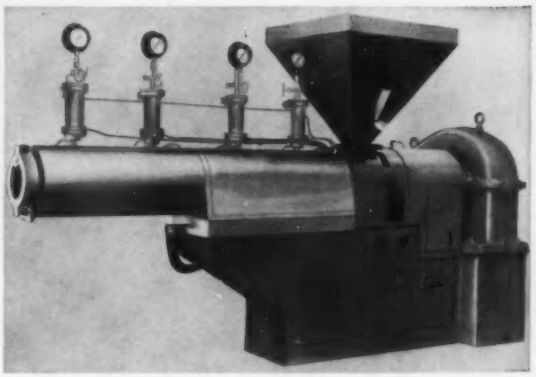
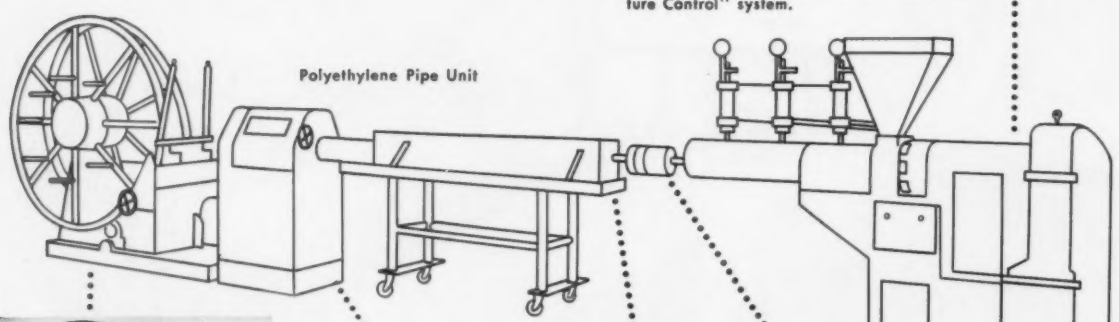
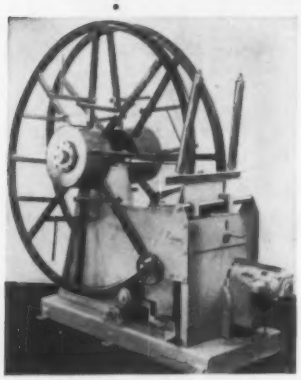
Complete extrusion installations or accessories available for pipe, film, sheet, shapes.



*EGAN EXTRUDERS: pre-set the temperature; "Willert Temperature Control" system takes over, providing completely automatic instrumentation.
*also available without "Willert Temperature Control" system.

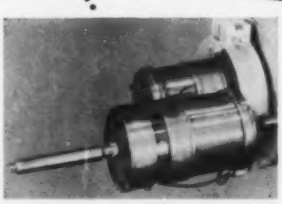


Polyethylene Pipe Unit



COILERS: dual reel type, with or without automatic level wind.

TAKE-OFFS: roller or multiple belt types in diameters of ½"—6" or 3"—14".



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In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

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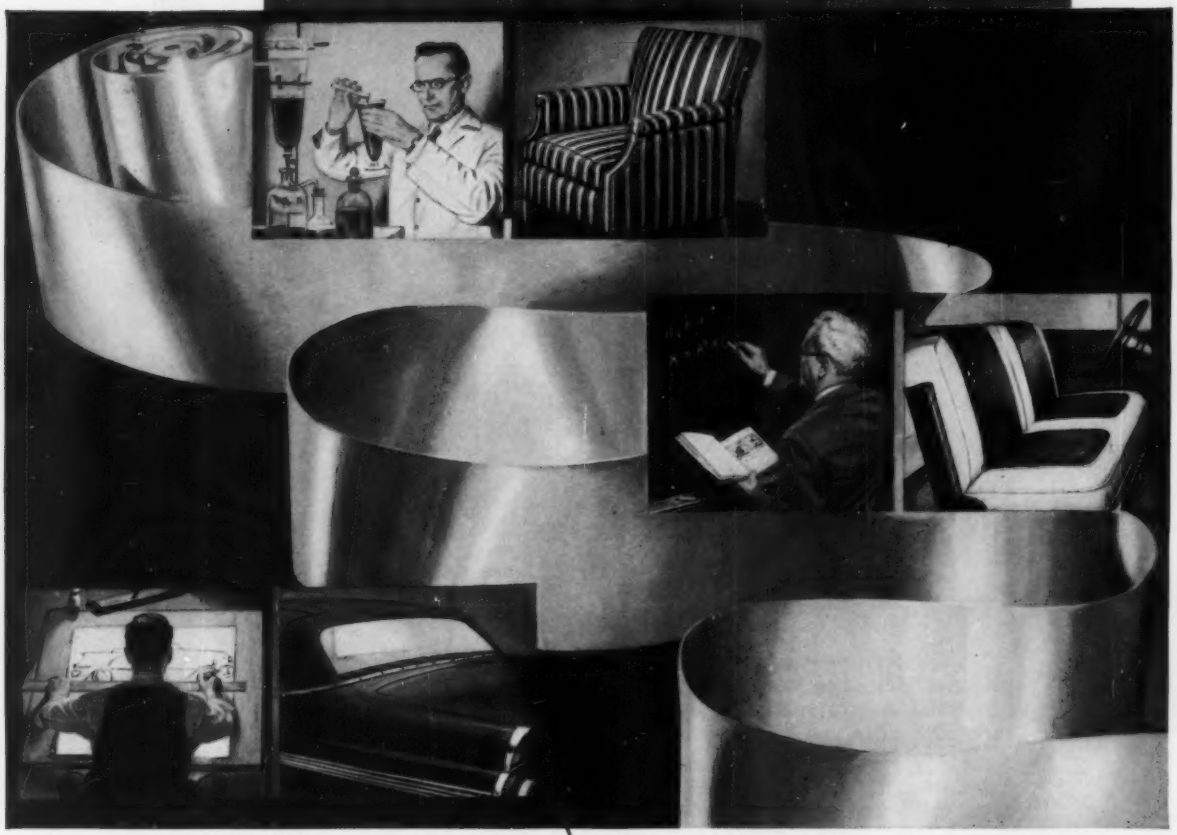

New improved Exon 900 series with tailored blending qualities means faster, more versatile production

. . . typical of the pin-pointed properties in Exon Vinyl Resins

Here is another addition to Firestone Exon's growing list of pin-pointed answers to specific problems: the new improved Exon 900 series.

These three new polyvinyl chloride resins offer many profitable advantages. The most important is greater versatility in both production and in the products you can make. For now Firestone gives you tailored blending to answer product and processing problems.

Firestone engineers have improved both the *absorptive* and *adsorptive* qualities of these new PVC resins. As a result, you get a greater pre-mix blending range, whether running hot or neutral. You can blend greater amounts of monomeric or polymeric plasticizer in the formulation. You get a wider area of temperature control.

To these temperature-tailored resins add the advantages of faster solvation, faster fusion rates in Banburys and mills, high quality, less fisheyes, greater product uniformity. New Exon 900 series resins give you greater dollar economies through quicker production.

Exon 911, 921 and 931 are just three of the resins in industry's most complete line of versatile vinyls. Another reason industry looks to Firestone Exon for engineered answers to its needs.

Consider your own production or product problem. Then for the resin properties pin-pointed to the best solution for you, check with Firestone.

Firestone

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INDUSTRY'S MOST COMPLETE LINE OF VINYLS ENGINEERED TO YOUR SPECIFIC NEEDS

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*MYLAR is DuPont's registered trademark for its brand of polyester film.

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For EVERY Industry: Latest developments in adhesives for Sandwich Panel Construction, Vinyl Film Bonding, also Rubber, Latex and Resin Cements, Pressure Sensitive Cements, Flocking Cements, Laminants, Sealants, Tie Coats and Resin Emulsions.

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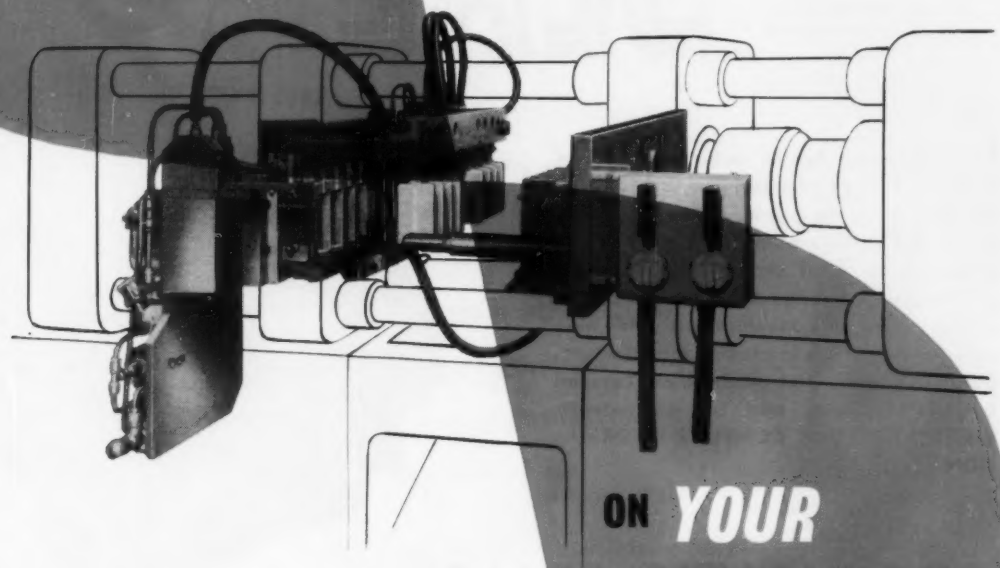

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MOLDED PLASTIC* PARTS

* POLYETHYLENE and OTHER THERMOPLASTIC PARTS

The Cosomatic Sealer automatically and without the use of adhesives, seals polyethylene parts on a production basis. This is the first commercially practical machine available for heat sealing molded polyethylene parts. It has been released after eleven years of development and nine years of actual use in product manufacture. Both the process and machine are covered by United States and foreign patents. WRITE TODAY FOR COMPLETE INFORMATION.

COSOMATIC SEALER

- Completely automatic sealing cycle.
- Accommodates a wide variety of shapes and sizes of hollow molded parts.
- Opens a new field of applications for polyethylene.
- Ideal for sealing toys, sporting goods, domestic and chemical containers, housewares and special industrial housings.

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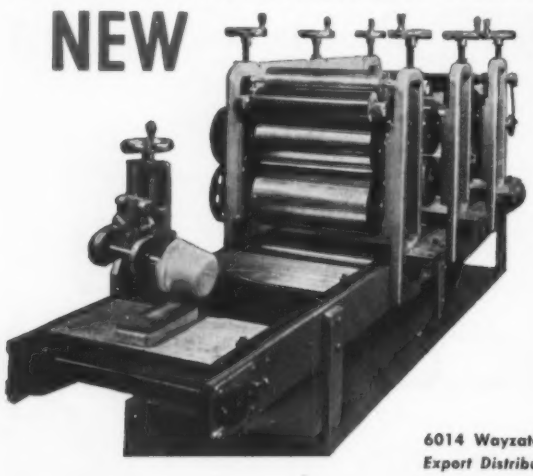
PGB Golf Ball—over 9 million have been sold. (Sealed ball and 2 halves shown.)

Bowlite Bowling Pin. Note Intricate Shape.

NEW COSOMATIC PRESS



Prints plastic items faster—better—at lower cost!

- Eliminates decals, hot stamping and slow, expensive silk screening.

Print plastic items never before possible. The Cosomatic Press prints either letterpress or offset—on *three* different levels—up to *three* different colors simultaneously! Flat, round, tapered, raised, or recessed faces can be printed in production or short runs, quickly, economically. Used by leading plastic product makers throughout the United States.

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For highest quality finished products, rely on Eastman plasticizers — made under the most exacting and rigid specifications in the industry. Samples and technical assistance furnished upon request. Also write for our booklet describing Eastman plasticizers and their uses.

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For all applications requiring moderate heat stability with good light stability. Excellent clarity in all vinyl resins. Has lubricating properties.

THERMOLITE 13

Powerful heat stabilizer. As an organotin maleate has dienophilic properties and thus prevents yellowing during processing of vinyl compounds at high temperatures.

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A complex organotin stabilizer that imparts outstanding light stability to all vinyls. Heat stability is excellent and gives crystal clear vinyls. Excellent for plastisols and organosols.

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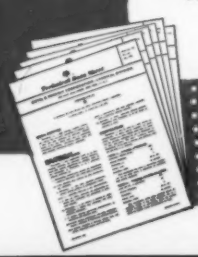

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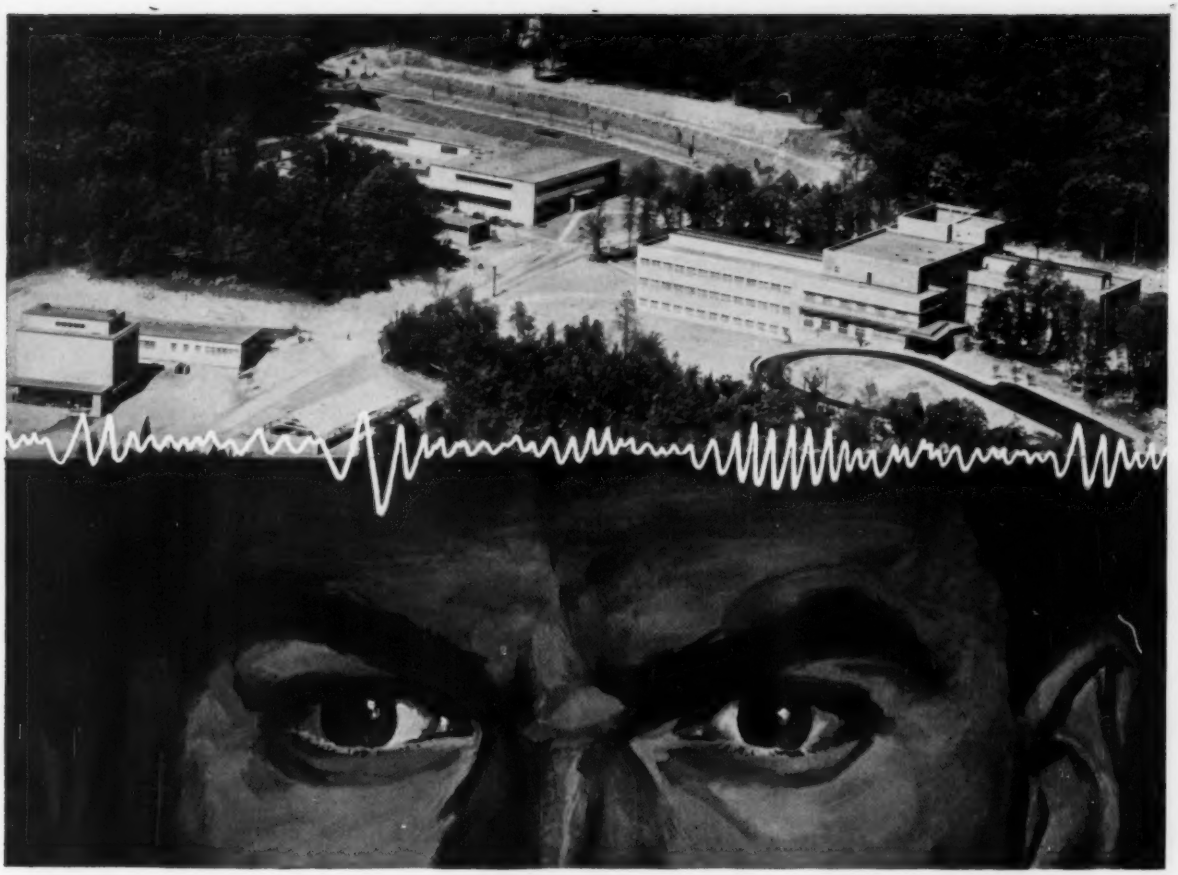

Here, creative minds will shape the future

Yes, here in the new Research Center of United States Rubber Company the probing minds of chemists and other scientists will find the ideal environment for conceiving new ideas...the finest facilities for bringing them into reality. Located on a 100-acre tract in suburban Wayne Township, New Jersey, the Center is a concrete symbol of the basic importance of Research in this company's past, present and future.

Significantly, at least 25 of U. S. Rubber's major product lines have been developed within the past twelve years.

As the Chemical Division of U. S. Rubber, Naugatuck Chemical continues to contribute a generous portion of new and improved products... such as Vibrin® 135, the high-heat-resistant polyester which has good strength retention at 500°F.

Such developments stem not only from our research laboratories at Naugatuck, but also from Naugatuck's agricultural research facilities at Bethany, Connecticut, and the laboratories of our Canadian affiliates, Naugatuck Chemicals and Dominion Rubber Company, Ltd. Now, Naugatuck's research will be substantially augmented—and perhaps channeled in radically new directions—by the more fundamental research carried on at the new Research Center.

In the future, even more than in the past, look for the name Naugatuck to identify *the newest and the finest* products in their respective fields!

United States Rubber

Naugatuck Chemical Division, NAUGATUCK, CONNECTICUT

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Rolls-Royce use Cobex

No other synthetic construction material combines the chemical resistance of COBEX with such ease of fabrication and low manufacturing costs.

In the new pickling shop at their motor car division in Crewe, Rolls-Royce have intricate ducting moulded from COBEX. This rigid vinyl sheet—light in weight, dimensionally stable, and non-inflammable—can be worked and moulded at a fraction of the cost involved in metal fabrication. The fine surface is hard-wearing and needs no painting or finishing. These are some of the advantages that make COBEX the ideal choice for this kind of installation.

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Agents all over the world

The high impact strength of film made from Spencer "Poly-Eth" 2200 series resins is demonstrated in this stop-motion photo.

In Film Extrusion . . .
"Poly-Eth" For Impact Strength:

Read why more and more extruders are switching to Spencer 2200 film grade resins for high impact strength:

A proven series of Spencer "Poly-Eth" film grade resins now makes possible the extrusion of polyethylene films with extremely high impact strength. These resins — Spencer's 2200 series—are designed to meet the rigid requirements of film for packaging produce, hardware and industrial items, as well as film for many construction applications.

Uniformly high impact strength is only one advantage of this "Poly-Eth" 2200 series. These resins offer excellent tensile strength and clarity as well as easy processing, fast take-off and greater output. Good draw-down is another important feature of these resins. For example, "Poly-Eth" 2206 is regularly used for the extrusion of film of less than one mil.

A full line of high impact resins is offered in Spencer's 2200 series. The resins are available in melt index of both two and four, with slip characteristics to meet your requirements. The following resins have a melt index of two: 2205 (no slip), 2215 (medium slip) and 2235 (high slip). These "Poly-Eth" high impact resins have a melt index of four: 2206 (no slip), 2236 (medium slip) and 2256 (high slip).

Why not learn for yourself why more and more extruders are switching to "Poly-Eth" 2200 series resins for film with uniformly high impact strength? Just drop us a line for more details, or for names of suppliers who have this film available. Write Spencer Chemical Company, Dwight Bldg., Kansas City 5, Mo.

Poly-Eth by SPENCER®

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3-2-1

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PRINTS
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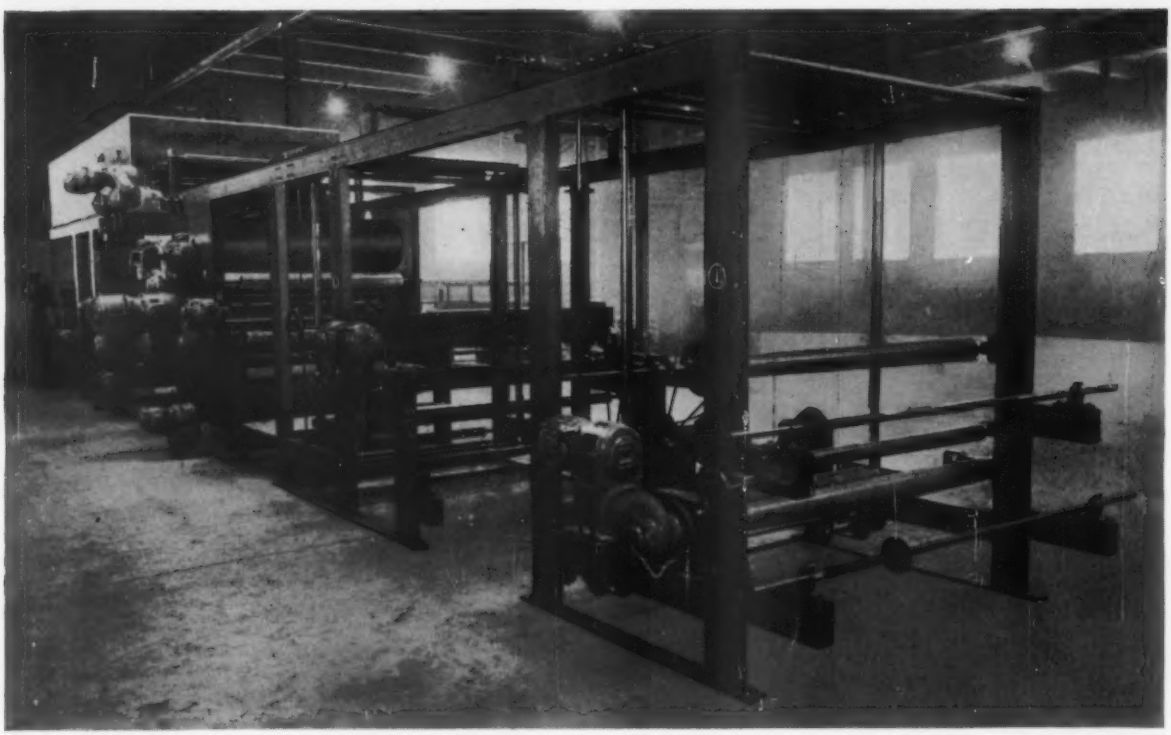

Save time, power, labor. The new Lembo laminator-embosser permits single or multiple operations on all plastic film via selective power drives!

The new 3-2-1 offers all the advantages of the dependable Lembo triple-function machine *plus* the added benefit of eliminating waste operations. More compact and efficient, this laminator-embosser is tachometer-equipped at all critical work stations for the complete mechanical coordination that saves on stress. Call now. We shall be happy to arrange experimental runs for you.

The Lembo 3-2-1 LAMINATES stretch back or drills without adhesives,* EMBOSSES and VALLEY PRINTS to closest tolerances.

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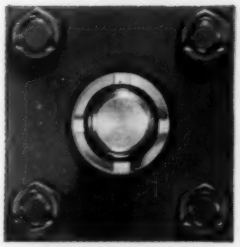
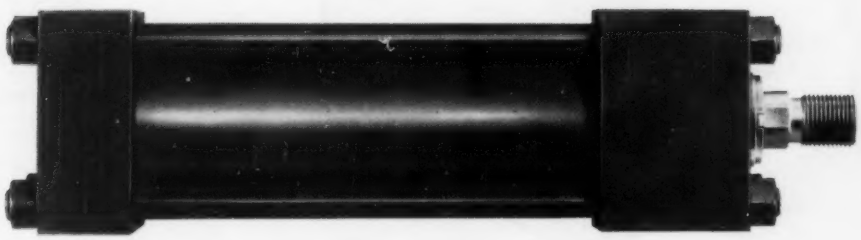


Made for the tough buyer



The discriminating engineer is intolerant—intolerant of anything but the very best in his plant and in his product.

For these tough buyers Hannifin cylinders are made. Into these cylinders go original, exclusive features of design, precision manufacture, and the ability to outperform others with the very minimum of maintenance.

You would expect to pay more for Hannifin cylinders. Actually there is no price premium. We can deliver them to you promptly in the sizes and mounting styles you require.

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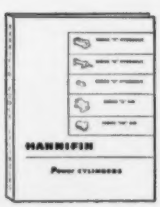
Write for your copy of this new Hannifin Cylinder File—complete, easy-to-use, easy-to-order-from information on five lines of Hannifin cylinders. Hannifin Corporation, 553 South Wolf Road, Des Plaines, Illinois.



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IC-1237 Polyester
Extremely fast wetting of glass fibers, fast gel time and rate of cure.

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IC-1259 Thixo Polyester
A companion resin to IC-1237. For use on large or small structures.

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IC-1241 Clear Gel Coat Mix with IC color concentrates. High gloss, exceptional water and weather resistance. Highly thixotropic.

For Making Your Own Gel Coats

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IC-480 Thixogel Polyester
To thicken other IC polyesters or for making a gel coat.

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IC Pigmented Gel Coats
Applied by spray to the mold surface to give a "molded-on" finish.

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IC Color Concentrates
For toning IC Colored Gel Coats and for pigmenting all IC Polyester Resins.

For a Mold Release Coating

IC-500
Spray directly to the mold surface to prevent sticking.

If you manufacture boats, tanks, advertising displays, seats, or other objects of unusual size or shape, it's time to look into IC* Polyester Resins and Accessories for hand lay-up molding. Each IC product in this team is specifically formulated to work in harmony with the others for better results, whatever your individual needs may be.

Consult your nearest IC Polyester specialist for facts about specific hand lay-up fabrication problems, or write for the new IC Hand Lay-Up Bulletin.

Specify an IC Complete Package of

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FOR

Hand Lay-Up Molding

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You too, will discover that the PEERLESS process of marking plastics is out-of-this-world. Practical, and yet inexpensive, is the PEERLESS method of trade-marking, identifying, and decorating parts and products made of plastics, paper, wood, fibre, leather, fabrics, etc. Engraved and embossed effects at high printing speeds . . . wide range of colors, including gold and silver. Stamping presses to meet every need . . . hand, electric motor, compressed air . . . semi to fully automatic feed and delivery. A PEERLESS Roll Leaf "label" does not wear or rub off, because it is engraved into the surface of the material, forming a permanent, integral part of the product. If you want proof of this "out-of-this-world" PEERLESS process of plastics marking, write or phone for samples or ideas.

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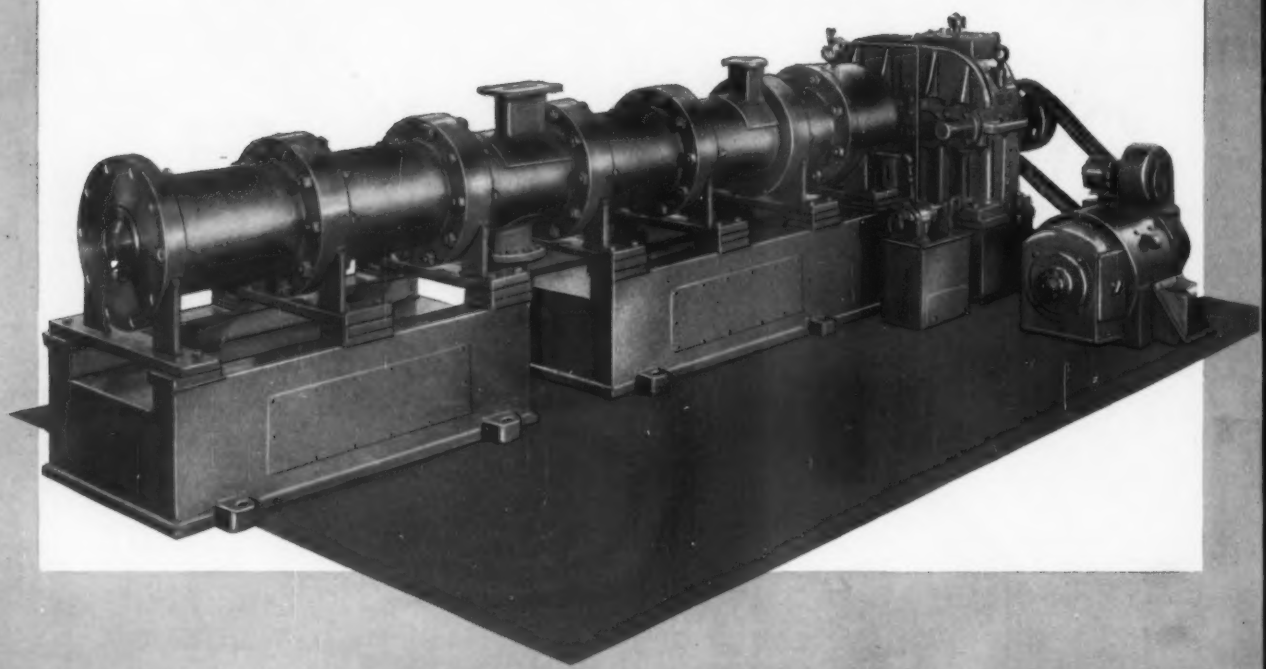

The 8" extruder illustrated fits into a special processing line. Custom designed for a large chemical company, the extruder had to be designed to coordinate with existing processing, blending and mixing facilities.

Extruders for standard operations can be off-the-shelf models but new processes, new products, new ideas require specific designs. For example, in the processing of polyethylene, we developed special extruders for simultaneous hot and cold feeding. In the fields of foamed plastics, polystyrene, polyethylene, the vinyls, we have designed many individual extruders for processing, blending, reclaiming and devolatilizing.

Most new ideas for special equipment originate in shirt-sleeve sessions with a company's production and engineering personnel. They know their process requirements. We translate these specifications into machines tailored to the job.

If you are working on new ideas in either plastics or rubber, H & K can be of assistance. We have specialized knowledge of these fields and can design a complete plant, a special process or an individual machine. We also have complete engineering service.

YOUR INQUIRY

For prompt response, please address your inquiry to:

Hale and Kullgren, Inc.
613 E. Tallmadge Ave. Akron, Ohio

Sales and Engineering by

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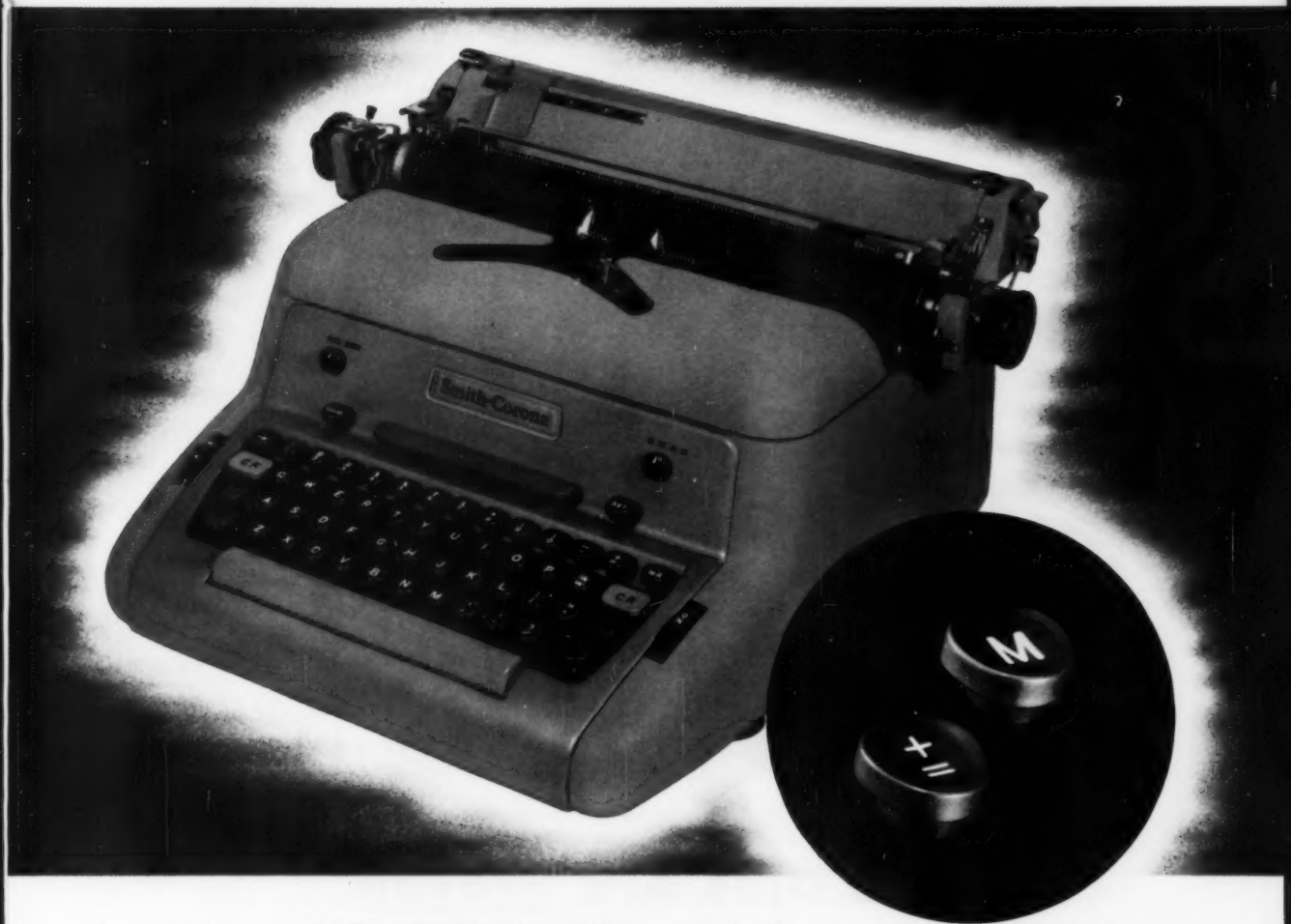
Beauty That's More Than Skin Deep !

AMERICAN "DOUBLE-SHOT" INJECTION MOLDING



keeps keys **LIKE NEW** the lifetime of the most durable equipment

American's DOUBLE-SHOT Injection Molding *is the ideal way of producing plastic parts with indicia molded in—keys for typewriters, calculators and other business machines—tuning dials—character wheels for registers, speedometers, counters—wheels with cams and gears for special purposes and scores of other applications where permanent indicia is needed.*

Look closely at the keyboard, platen knobs, and other controls on this beautiful Smith-Corona typewriter. Note the clearness of the symbols and numbers. Look again at this same keyboard after years of hard service and you'll see the same "brand new" beauty. You'll find the keys just as brilliant . . . just as readable and indestructible. The secret is below the surface. These parts were formed by American Plastics which has mastered the patented process of Double-Shot Injection Molding.

With this process, letters, numbers and symbols are formed from a separate plastic part, not imprinted or filled in. Get the facts on this surprisingly economical process by *writing direct* to *American Plastics*, one of America's largest suppliers of Double-Shot Injection Molded parts. Address Dept. B.

A P C
PRECISION MADE

AMERICAN PLASTICS CORPORATION

A Subsidiary of Heyden Newport Chemical Corporation

EXECUTIVE OFFICES: 342 MADISON AVENUE, NEW YORK 17, N. Y.

PLASTICS PRODUCTION PARTNER OF AMERICA'S MOST PROGRESSIVE MANUFACTURERS

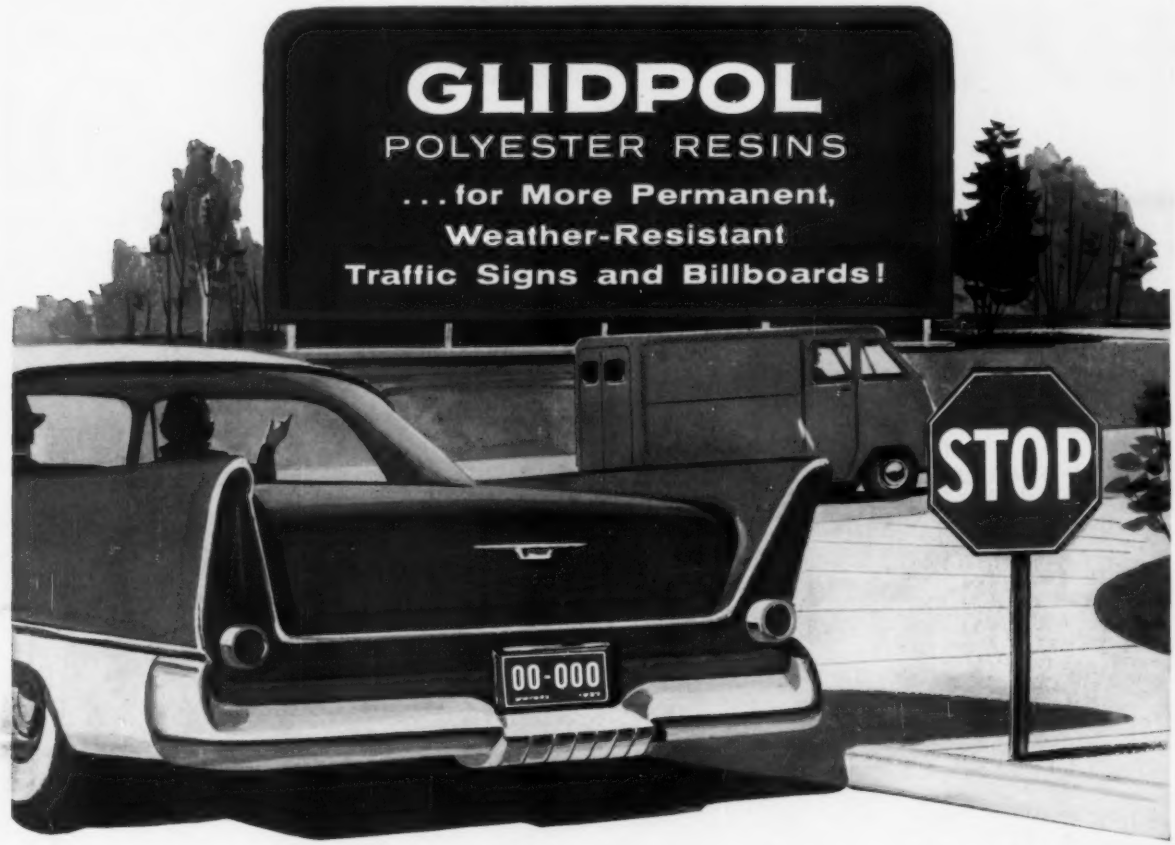
Robbins Dies Are Proven

At a glance . . . a good idea of Robbins tool making talent. These are cross-sectional areas of custom parts in both flexible and rigid extrusions. Once your die is completed it is sent to our own test extruder where samples are made and rigidly inspected. In short, we *prove* the die before you get it—and we would like to *prove* this point to you. Soon!

Robbins — never say die . . . say Robbins die

Robbins test every sectional die before shipment.
We also develop many processes for specialized extrusion.

PLASTIC MACHINERY CORP.
1430 Mishawaka Street • Elkhart, Indiana
Subsidiary of Lynch Corporation, Anderson, Indiana, U. S. A.



You, as a fabricator, may find new markets for your production in these applications.

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They're attractive and eye-catching too, because GEL-KOTE*, the pigmented GLIDPOL coating resin, provides a smooth, splinter-free surface plus permanent fade-proof color. Tough, durable GEL-KOTE polyester coatings protect against damage from weather or extreme temperature variation.

Versatile GLIDPOL and GEL-KOTE resins are also used in the production of license plates, motor vehicle bodies, luggage, aircraft parts, boat hulls and hundreds of other products.

*A Glidden Trade-Mark

A request on your company letterhead will bring you a copy of Technical Bulletin BW-1057 which fully describes all of the Glidden GLIDPOL resins for casting, laminating, molding and coating.

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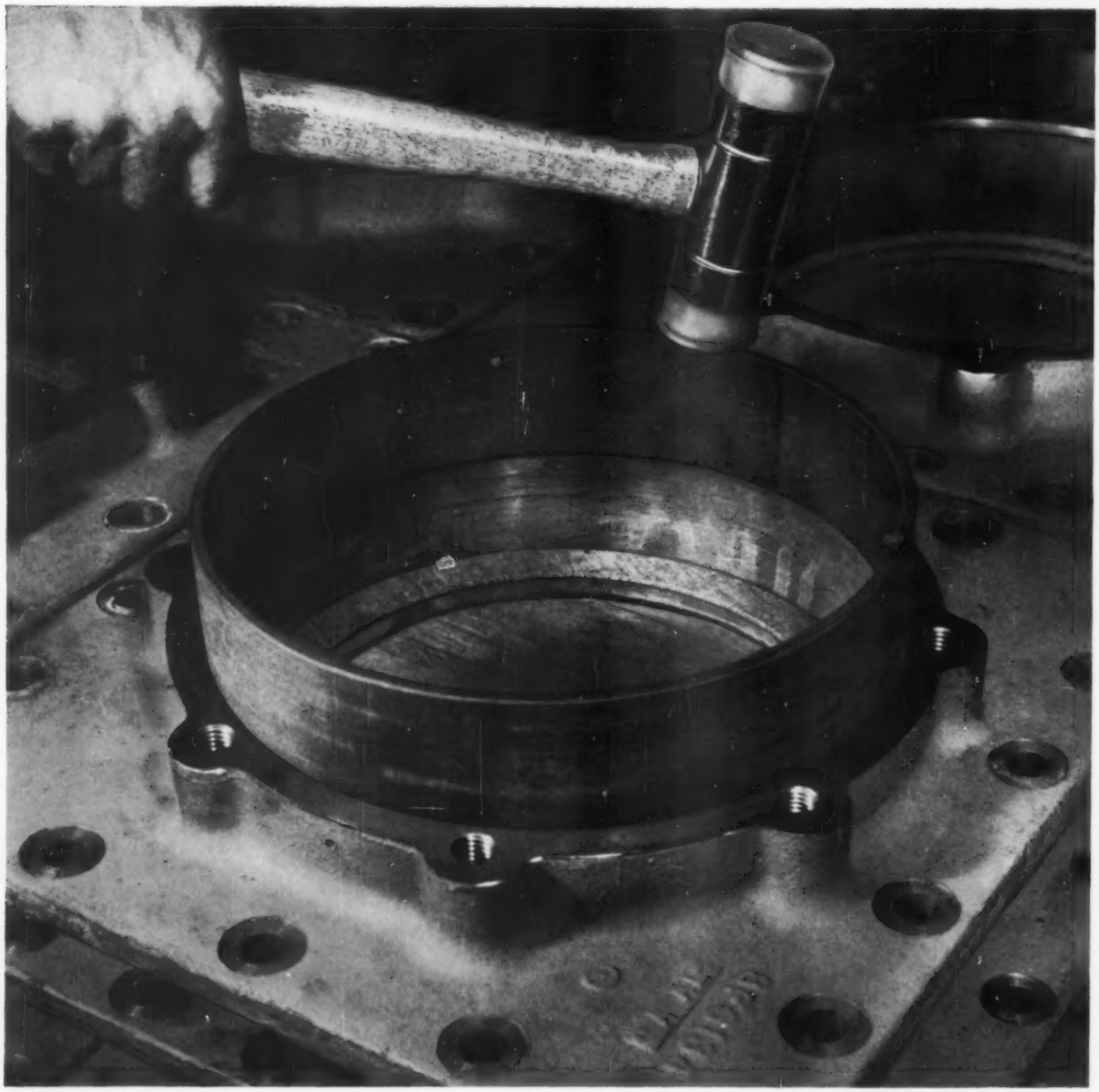

CAT* CRADLE – The extremely rugged field conditions to which heavy construction equipment is constantly subjected has made the engineers of Caterpillar Tractor Co. experts at solving complex material and metallurgic problems. In the construction of the tandem drive housing used in Caterpillar's No. 112 Motor Grader, for example, special bushings were required that could operate, not only with a minimum of lubrication, but would withstand the constant rocking and heavy shaft loads as well. For this purpose, Caterpillar* adopted special laminated phenolic plastic bushings which are graphite impregnated and able to stand up under these extremely severe oscillating conditions. These bushings were manufactured by The Richardson Company of Melrose Park, Illinois, using Mount Vernon Duck.

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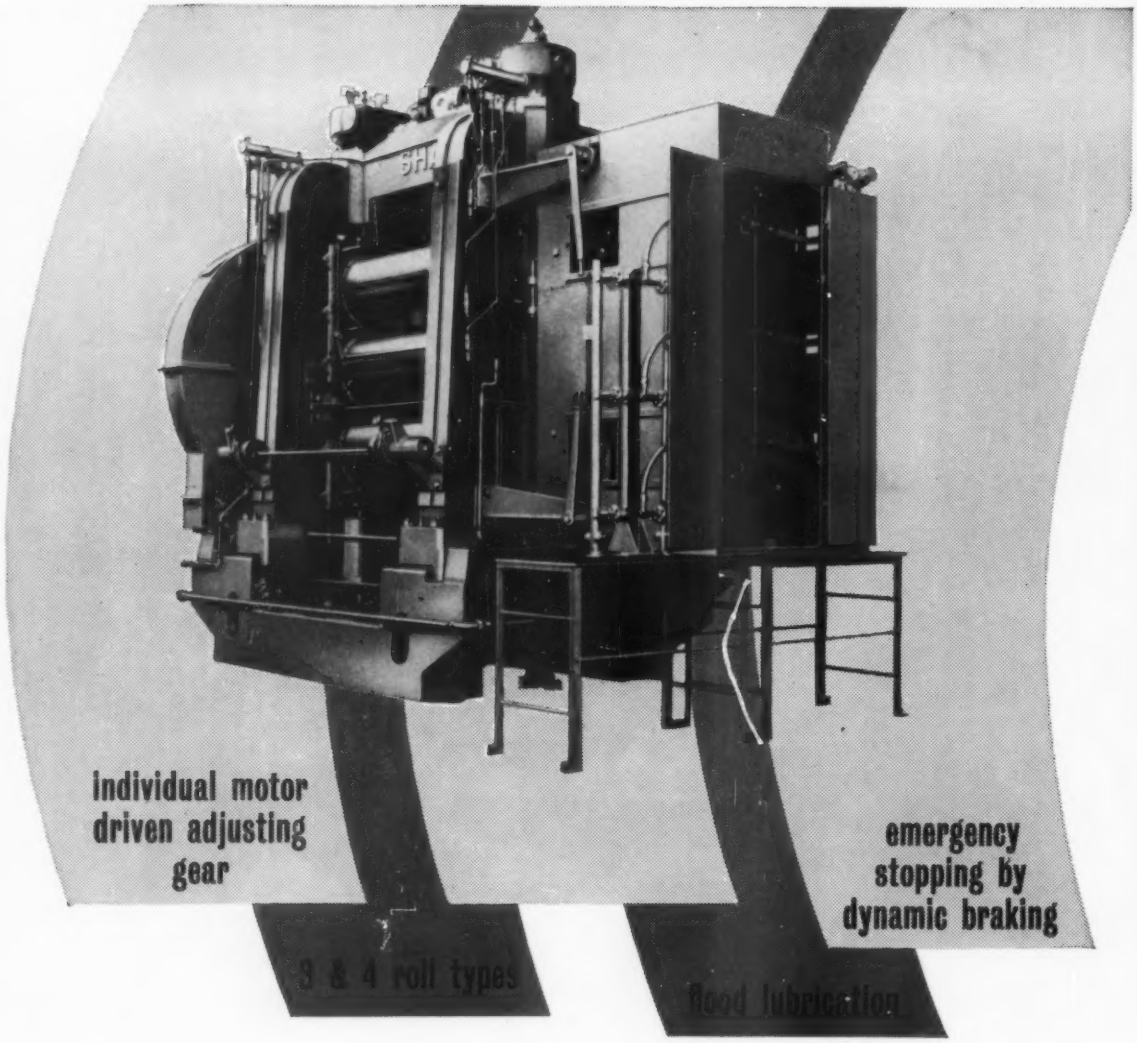

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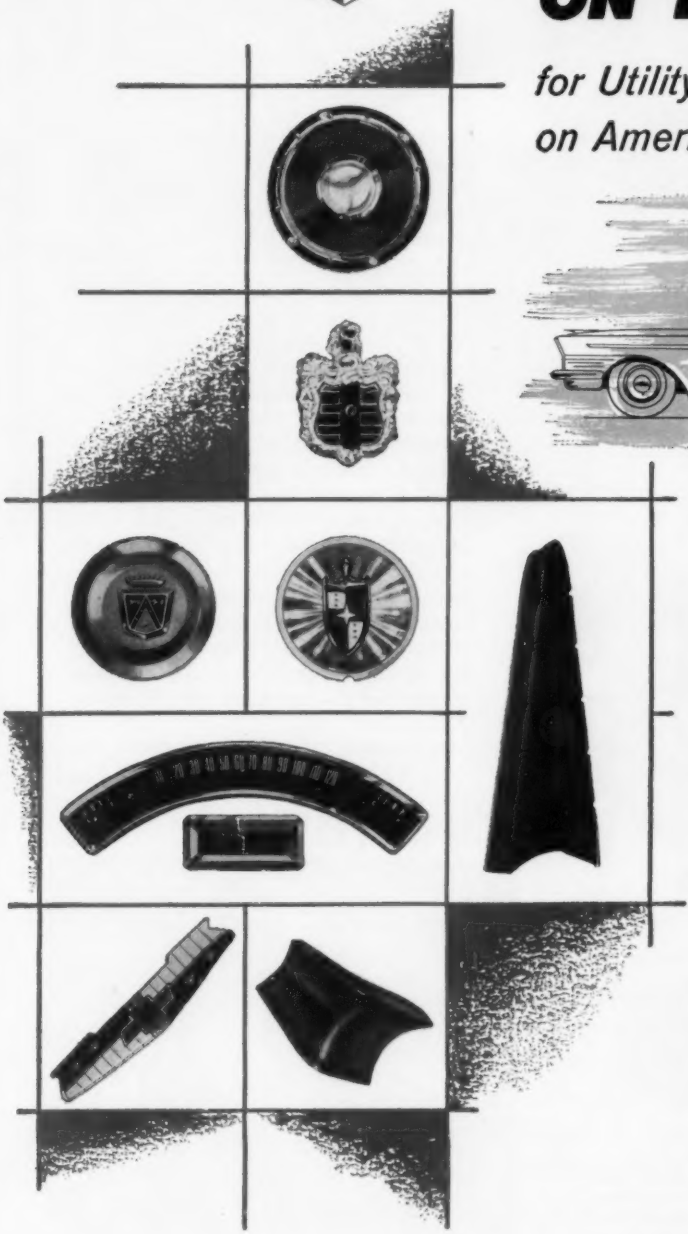

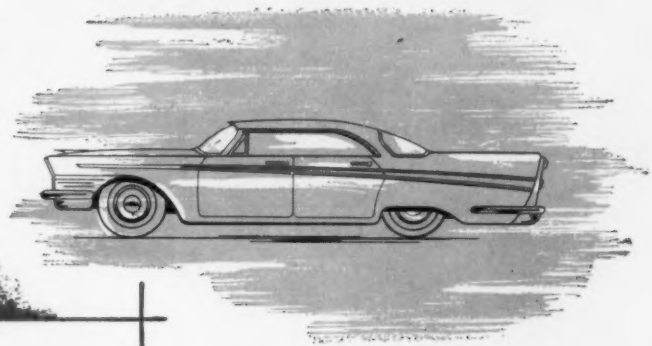

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ERIE Three Dimensional Plastics in horn buttons, nameplates and ornaments are the last word in beauty . . . and the wide arc speedometer dial is given an added appeal by ERIE External Metallizing; an economical finish for plastic, equal in richness and lasting luster to electroplating on metal and with almost unlimited possibilities for application to other articles.

Write for a copy of the new ERIE Plastics Facilities Bulletin.

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Companion Machine For Mold and Die Millers

Toolmaster

Style 1B Toolmaster Milling Machine. Equipped with 1 hp spindle head; collet chuck type spindle nose, capacity ⅛" to 1" shank cutters; power feed to quill; worm positioning of swivel head. Catalog No. M-1870-4.

Every die shop needs one or more Toolmasters to handle the simple milling operations at the lowest cost. Toolmaster performance is tops. They're sturdily constructed to take straight and angular milling cuts up to 1 hp capacity; they're easy and convenient to operate. And there's no end to the advantages of Toolmaster features. Large no-glare dials are easy to adjust for depth of cut . . . overarm is equipped with a pinion for easy positioning . . . spindle lock to facilitate changing of cutters . . . spindle motor starting switch located on the head . . . Shaping Attachment and a host of additional extra equipment. A brief review of your shop facilities will quickly show how Toolmasters can relieve the pressure of work on expensive die sinking machines. Write for our attractive catalog No. M-1870-4, or look in Sweet's Machine Tool File for brief specifications.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

The Toolmaster's smooth, accurate manual feed is a big help in milling the inside of box shaped sections . . . the operator can readily work with two hands on the controls while watching the cutter.

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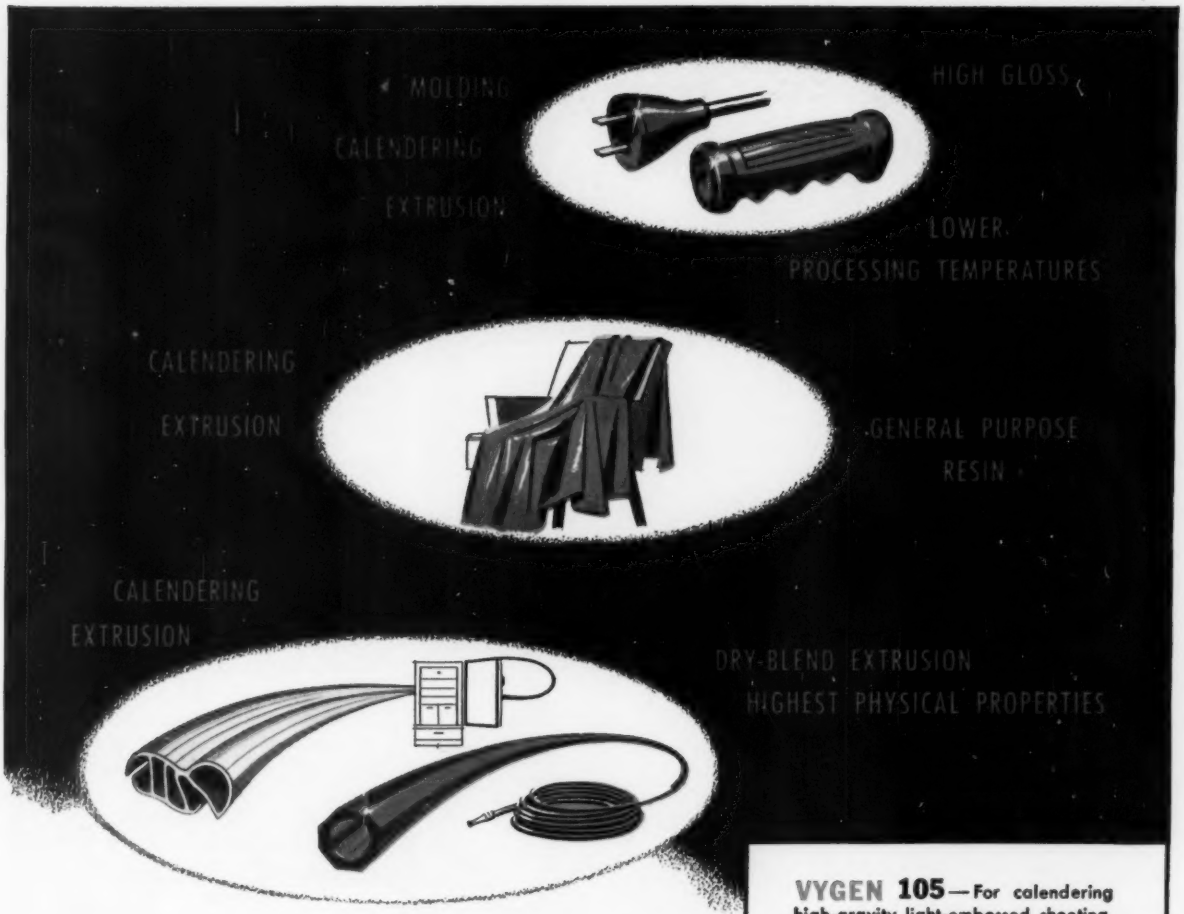
MILLING MACHINES • BROACHING MACHINES • CUTTER AND TOOL GRINDERS • SPECIAL MACHINE TOOLS • METAL FORMING MACHINES HARDENING MACHINES CUTTING FLUID • GRINDING WHEELS



There's a specialized VYGEN® resin for every application

With the development of these specialized vinyl resins, General's Chemical Division is prepared to put the *right* PVC resin to work for you. All three have good heat and light stability, high-bulk density, very good clarity and exceptional uniformity. For technical assistance and detailed information on the VYGEN resin for *your* operation, just drop us a line on your company letterhead. We'll be glad to work with you on that "tough" problem.

VYGEN 105—For calendering high-gravity light-embossed sheeting, and for molded items and extrusions requiring a high-gloss finish. This resin can be processed alone or with other resins, permitting lower processing temperatures.

VYGEN 110—A general purpose, average molecular weight resin, especially adapted for easy processing of calendered film, sheeting and coated fabrics . . . also recommended for certain molding and extruding applications.

VYGEN 120—A high molecular weight resin ideally suited to dry-blend extrusion operations with monomeric or polymeric plasticizers . . . excellent, too, for calendering when maximum physical properties are desired.

Chemical Division GENERAL
THE GENERAL TIRE & RUBBER CO. VYGEN

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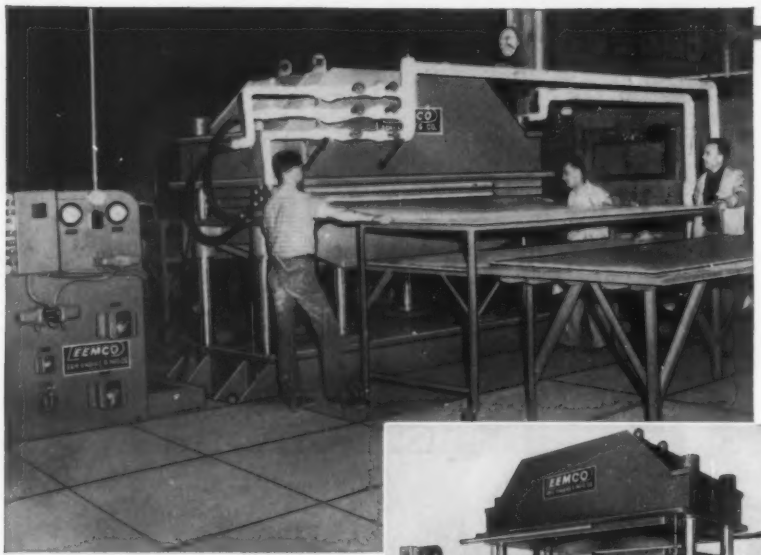
Alsynite COMPANY OF AMERICA selects ERIE ENGINE & MFG. CO. *PRESSES*

to make fiberglass shatterproof window panes!



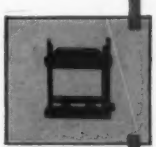
Especially designed and custom built for Alsynite, this EEMCO press was recently installed in their Portsmouth, Ohio plant. More and better production has been achieved. Automatic features have eliminated costly mistakes and greatly reduced time loss and rejects. Just as Alsynite has developed a completely new approach to industrial daylighting with their scientifically designed shatterproof window panes, so has EEMCO shown the way to increased and stabilized production and enabled them to give their customers a higher quality and more uniform product

INVESTIGATE EEMCO FOR YOUR RUBBER AND PLASTICS PROCESSING NEEDS AND PROBLEMS

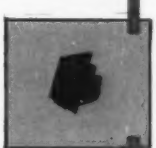
The competent engineering staff and experienced workmen of EEMCO are ready to help with any production problem you may have—before you buy, investigate EEMCO delivery, specifications and prices. EEMCO designs and builds a complete line of mills and hydraulic presses for the rubber, plastics, wood products, and fiberglass industries.

Pictured above is the 102″ x 60″ EEMCO 110 ton hydraulic press built for Alsynite—complete with automatic cycle controls and pressure regulators. Other EEMCO installations have achieved similar successes and helped owners toward the goal of more and better production. Why not investigate EEMCO for your hydraulic press requirements?

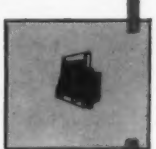
REINFORCED FIBERGLASS MOLDING PRESSES



DOWN OR UP ACTING PRESSES *(OPTIONAL)*



FIBERGLASS PREFORMER *(ALL SIZES)*



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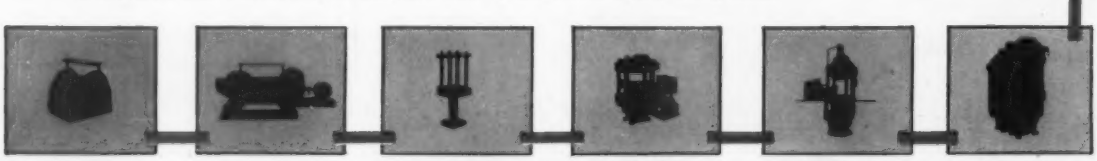
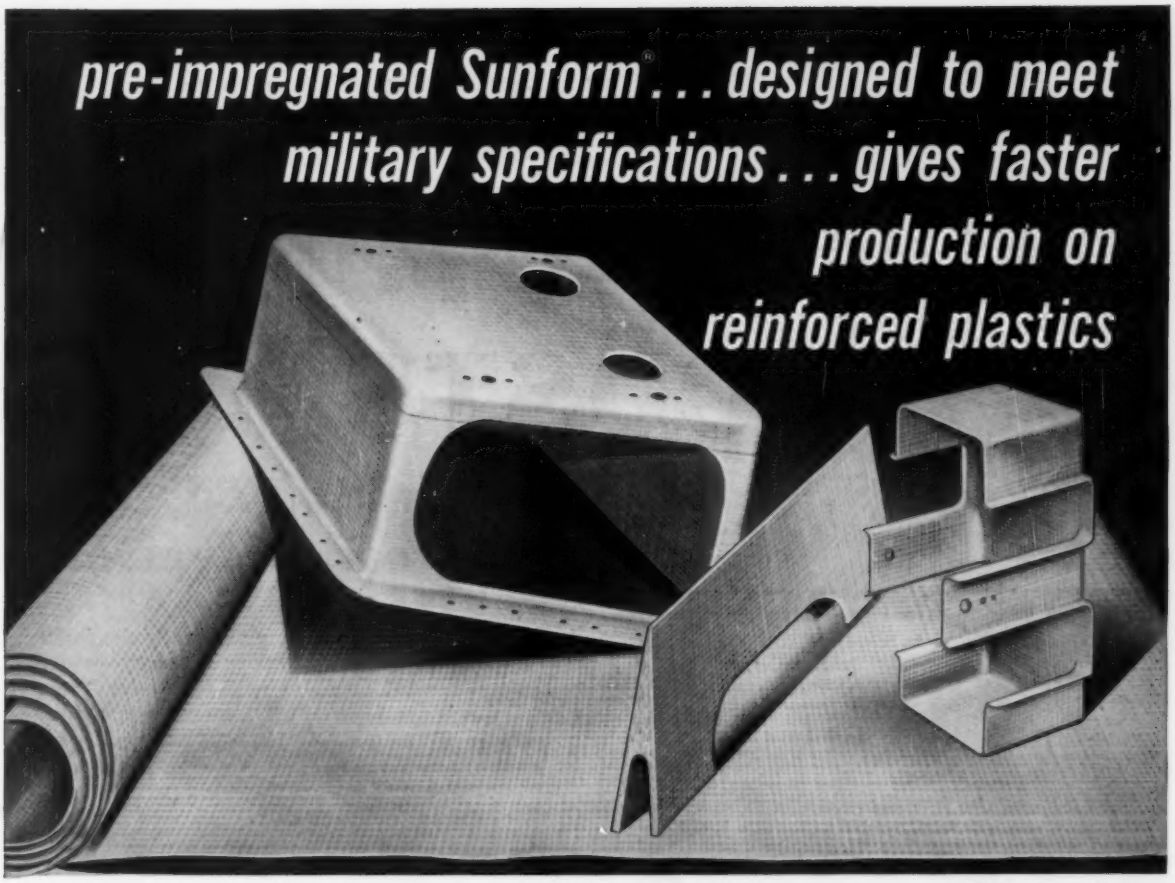
Designers and builders of a complete line of mills and hydraulic presses



LABORATORY MILLS | MILLS | LABORATORY PRESSES | COMPRESSION MOLDING PRESSES | TRANSFER MOLDING PRESSES | LAMINATING PRESSES



Available at low cost and in widths over 100 inches

Recent developments have resulted in new SUNFORM formulations and a new polyester resin that substantially lowers cost while maintaining the same high specifications. In addition to Sunform polyester, pre-impregnated materials using epoxy, phenolic, melamine and silicone resin systems, as well as custom impregnations for low pressure laminating work, are also available.

SUNFORM is uniformly pre-impregnated with resin plus catalyst, yet it unrolls ready to mould and lays-up like plain cloth. This easy lay-up saves time and money. Controlled resin impregnation means fewer rejects, no delamination during machining, void-free laminates with multiple layers (even on intricate shapes). Reinforced plastics made with SUNFORM have high tensile and flexural strengths, exceptional stability even under extremes of temperature and humidity. Dielectric strength is high, loss factor is low and moisture resistance is excellent.

SUNFORM is resistant to mild acids, alkalies, common solvents, rot, mildew, fungus. SUNFORM polyester has a shelf life of six months. Can be stored at room temperatures . . . no refrigeration required.

SUNFORM polyester cures in 2 to 5 minutes at 240°F to 280°F—low pressure. Suitable for all types of low pressure molding (matched dies, vacuum bag, pressure bag or contact pressure). Available in Fire Resistant, Regular or special Heat Resistant types. Selection of colors (large orders) and a variety of glass cloth weaves and finishes from .003" to .090".

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...with molded reinforced polyester

Assembly time is cut to the bone and machining is eliminated when you design with ATLAC Thermaflow molding compounds in mind. Complex multi-piece assemblies can often be molded in one rigid piece, complete with molded-in bushings and fittings. Machining is made unnecessary by precision molding techniques and excellent surface finish. Surfaces need no painting—the part is corrosion resistant and available in colors.

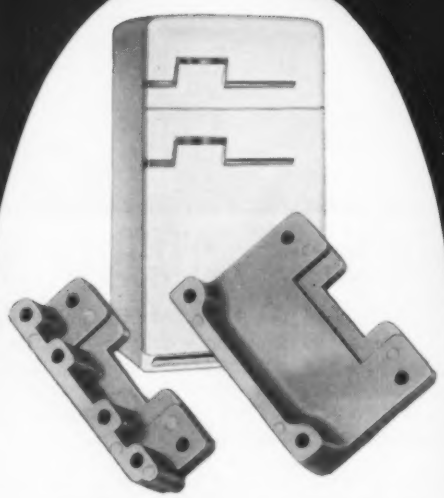
In addition, ATLAC Thermaflow materials offer;

- **Weight savings: specific gravity 1.8**
- **High impact and flexural strength**
- **Superior corrosion resistance**
- **Excellent electrical insulation and arc tracking resistance**

To the molder—

ATLAC Thermaflow materials are easy to mold in large shapes, with deep draw and intricate detail. Reinforcement flows evenly throughout the piece . . . no weak spots at corners or edges. Compression or transfer mold them on standard presses, at temperatures from 275-350°F., and pressures from 500 psi and up. Curing time is relatively short.

A wide range of glass fiber and nylon rag reinforced grades is available. Write today for literature on materials, molding recommendations and applications.



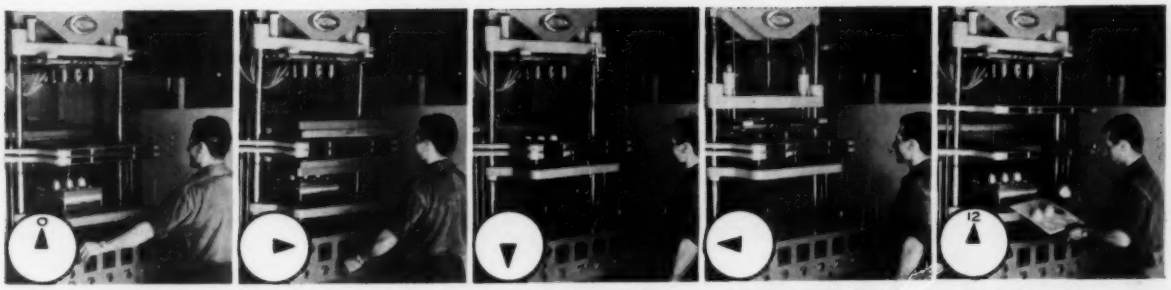
SIMPLER ASSEMBLY FOR Servel

Bracket and support for refrigerator liner and evaporator, molded of ATLAC Thermaflow compound, replace (1) multiple-piece assembly of steel part, spacer and fasteners and (2) machined piece of laminate. Gave superior thermal insulation, better shock resistance, simplified manufacture. Molded for Servel, Inc. by Kurz-Kasch, Inc., Dayton, Ohio.

ATLAC THERMAFLOW

ATLAS

ATLAS POWDER COMPANY
Chemicals Division
Wilmington 99, Delaware



Parallel clamp frames close on plastic sheet, holding it securely.

Sandwich heaters move forward to deliver heat to top and bottom surfaces of sheet.

Heaters retract as molds move up into plastic, automatically activating vacuum valve.

Heated cutters descend and die cut formed parts on mold.

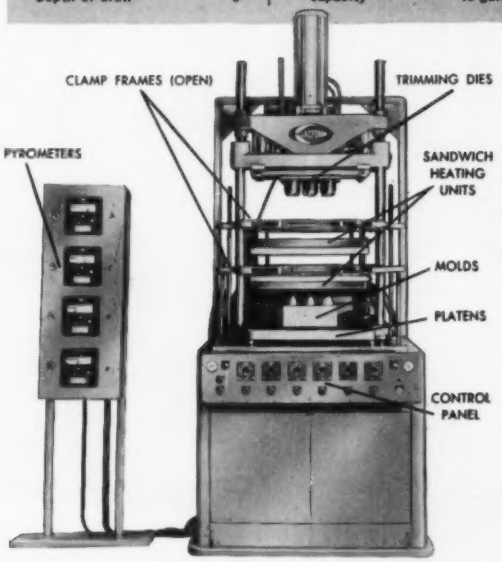
Operator removes sheet and trimmed parts held in web.

PLASTIC SHEET TO FINISHED PRODUCT...

VAC-TRIM does the complete job in 12 seconds

Specifications VacForm Model 246 (Vac-Trim)

Dimensions	4½' W x 10' L x 11' H	Heater capacity	32.4 kw
Weight	7200 lbs.	Heater temperature (max.)	1100° F
Mold size (max.)	24" x 24"	Vacuum pump	28 cu. ft./min.
Depth of draw	9"	Vacuum surge tank capacity	40 gal.



From plastic sheet to cups and tops in 12 seconds ... that's a typical Vac-Trim achievement. This new 3-in-1 machine combines straight vacuum, drape, and plug forming; also trims automatically. You save the cost of additional equipment, floor space, labor. You gain in flexibility, fabricating range ... can produce almost any product shape with this single machine.

Cleaner, more precise finishing

Temperature-controlled cutting dies, designed for each fabricating job, cut product shape from sheet immediately after each forming cycle. Product separation takes place before plastic cools and hardens ... gives you better-looking, more exact end-product.

"Sandwich" heating steps up production

Two high watt density heaters reduce some heating cycles as much as 75 per cent, increase your selection of plastics, permit use of heavier gauge materials.

VacForm builds an extensive line of automatic and semi-automatic machines for production and research. Learn how you can employ VacForm versatility to solve production problems, reduce material and equipment costs, improve your position in the market. Write for catalog, other informative booklets.

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As the principal producer, National Aniline's fully-integrated volume output and fast deliveries from our strategically-located Moundsville plant expedites your production and minimizes your inventory.

And because the quick-dissolving, uniform round tablets resist degradation in handling, they are essentially non-dusting and give you fewer fines.

We will be happy to send you a sample of this high-quality, versatile intermediate. Write to the nearest National Aniline office.

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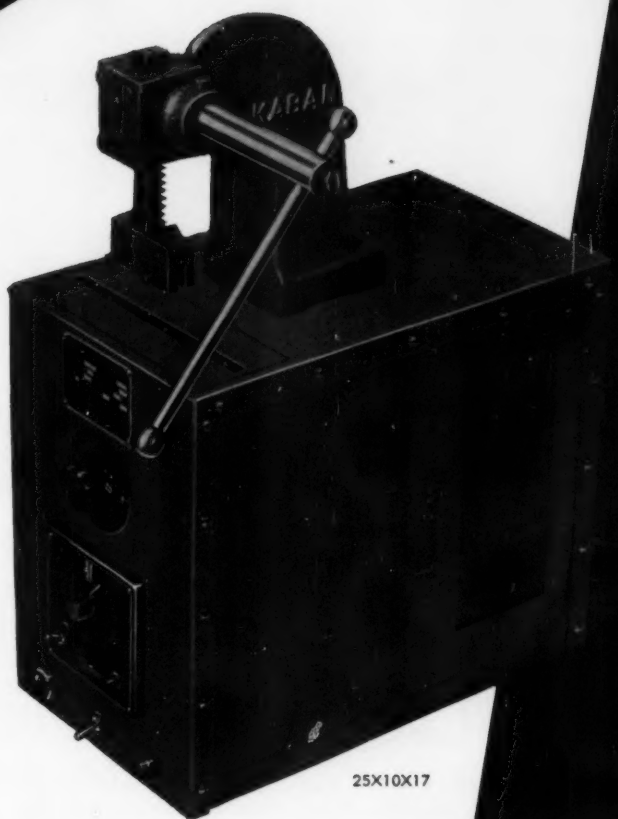
New! LOWEST PRICED HEAT SEALER IN THE WORLD!

Kabar's *Mighty* Portable



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- Electronically Seals Vinyl Film and Sheet; Vinyl Coated Materials; Acetate Sheeting; Saran; Rigid Vinyl. Cloth to Plastic - small blister packaging.
- No Screening or Shielding necessary when operated in accordance with instructions.
- Operates from standard 115 Volt Outlet . . . JUST PLUG IT IN! No special power lines. No air lines.

IDEAL FOR:

REPAIRING
EMBOSSING
SPOT SEALING
GUSSET SEALING
VALVE SEALING
REINFORCING
MATERIAL TESTING
SEAT COVER REPAIRING
DESIGN AND SAMPLE WORK
ACETATE ENVELOPE SEALING
PACKAGE SEALING (Acetate, Vinyl, Saran)

. . . and 1001 other small operations!

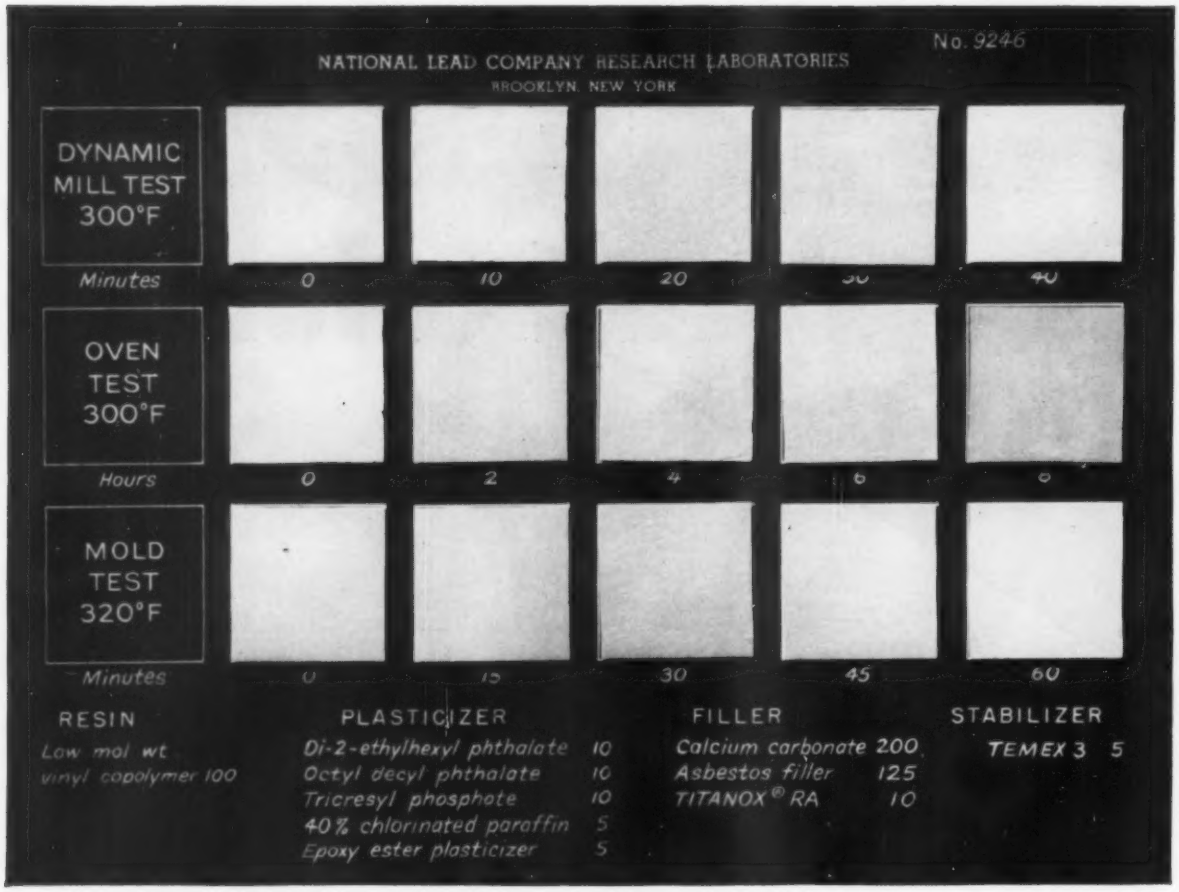
Air or foot operation available at additional cost.

SO EFFICIENT . . . SO RUGGED . . . SO LOW-PRICED . . . all manufacturers will want several MIGHTY PORTABLE UNITS!

WRITE . . . WIRE . . . PHONE . . . FOR DETAILS NOW!

Kabar MANUFACTURING CORPORATION

1907 WHITE PLAINS RD., N. Y. 62, TA 3-5104



How's this for color retention?

New stabilizer..."Dutch Boy" Temex 3... gives 3-way better color control in vinyl-asbestos flooring

This test card shows what you can expect from asbestos-filled vinyl flooring stocks stabilized with the new "Dutch Boy" stabilizer . . . Temex 3.

In these stocks, this specially-developed barium-zinc compound gives you a 3-way better control over color during processing:

Best yet for heat stability

Mill, mold and oven tests are alike in demonstrating that "Dutch Boy" Temex 3 stabilizer provides greater heat stability than ever before attainable for vinyl asbestos-filled flooring.

Complete freedom from interactive color change

Temex 3 stabilizer has minimum reactivity . . . does away with pinking, bluing and other color shifts associated with interaction between stabilizer and filler impurities.

No harmful lubricity

Temex 3 stabilizer adds no lubricity to the compound. At any recommended level of stabilizer, critical color values in whites and pastels can be maintained . . . color separations kept sharp.

Steps up color life, too

Along with improved color control during processing, "Dutch Boy" stabilizer Temex 3, also assures improved color life after flooring is laid . . . preventing discoloration or staining by sulfur compounds.

Other "Dutch Boy" stabilizers meet other vinyl flooring needs . . . Tribase and Normasal®, for other loaded stocks . . . Clarite®, for homogeneous non-asbestos stocks. Still others . . . seventeen more, in fact . . . improve other vinyl products.

Seeking to improve *your* vinyl formulations? If so, look into these versatile "Dutch Boy" stabilizers. A new edition of the "Dutch Boy" Stabilizer Handbook is available. Ask for a copy.

Dutch Boy® CHEMICALS

NATIONAL LEAD COMPANY

111 Broadway, New York 6, N. Y.

In Canada: CANADIAN TITANIUM PIGMENTS LIMITED
630 Dorchester Street, West, Montreal

Thin wall clear polystyrene containers are formed in this mold of CRUCIBLE CSM 2. Mold Builder: Standard Tool Company, Leominster, Mass.

they picked ultrasonically inspected

CRUCIBLE CSM 2

from warehouse stocks

FOR HIGHER FINISH . . . LONGER MOLD LIFE – It takes a highly polished and dimensionally accurate mold to form clear styrene into these thin walled containers. And, because production-runs go into the millions, the mold steel has to be long lasting. Both are good reasons why CRUCIBLE CSM 2 was selected.

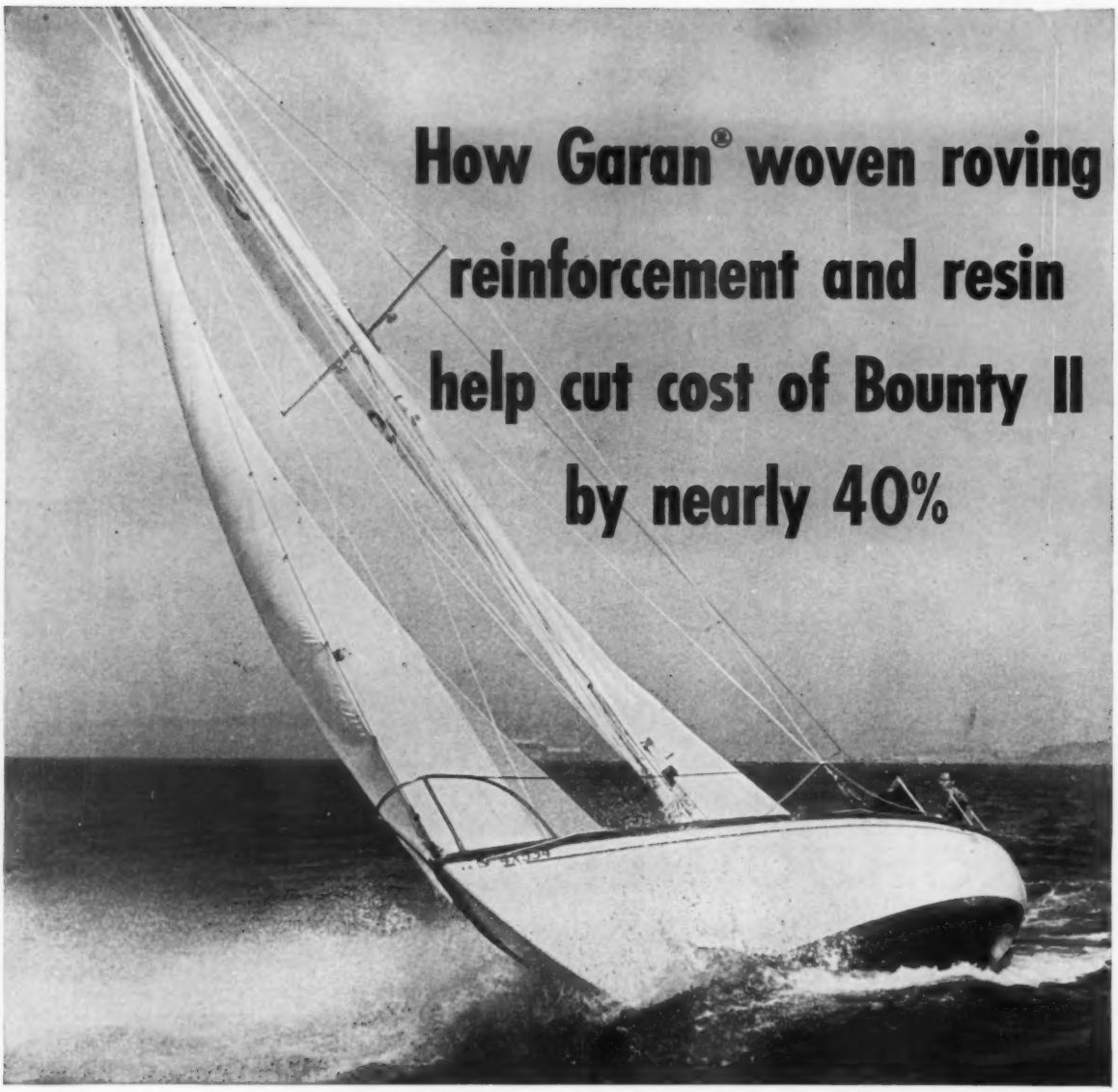
For CRUCIBLE CSM 2 is an exceptionally *clean* steel—uniform in composition and structure—with superior machining and polishing characteristics. And for absolute dependability, *every piece* of CSM 2 is ultrasonically inspected.

What's more, for your convenience, CSM 2 is immediately available from Crucible *warehouse stock* in 205 sizes. Next time you need mold steel—call Crucible. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor—Railway & Power Engineering Corp., Ltd.



How Garan® woven roving reinforcement and resin help cut cost of Bounty II by nearly 40%

Molded hull, deck and mast of 40′-10″ Bounty II are made with Garan woven roving. Builder: Coleman Boat & Plastics Co., Sausalito, Calif.

Garan woven roving reinforcement helps make it possible to mold a 40-ft. Bounty II per week—at nearly 40% less than the cost of comparable wooden boats. Here's why:

Garan woven roving cuts production time and labor costs because it wets out 3 to 5 times faster. It conforms well to the mold . . . saves extra cutting and fitting. Because its greater bulk makes build-up 2 to 3 times faster, it costs less to use. And finished moldings are color-true because Garan woven roving adds no color of its own to pigmented resins.

Garan woven roving is a coarse, fabric-like reinforcement made from bundles of parallel glass fibers. The exclusive Garan sizing protects fibers during weaving, and improves glass-to-resin bond. This gives Garan woven roving special strength . . . makes possible stronger, more durable laminates.

These are the reasons why Garan woven roving is preferred by manufacturers of reinforced-plastic products such as boats, chemical piping, tanks, tooling fixtures, swimming pools and radomes. Find out today how *you* can profit from the time-saving, moneysaving properties of Garan woven roving. For sources of supply, write: *L·O·F Glass Fibers Company, Dept. 15-107, 1810 Madison Ave., Toledo 1, Ohio.*

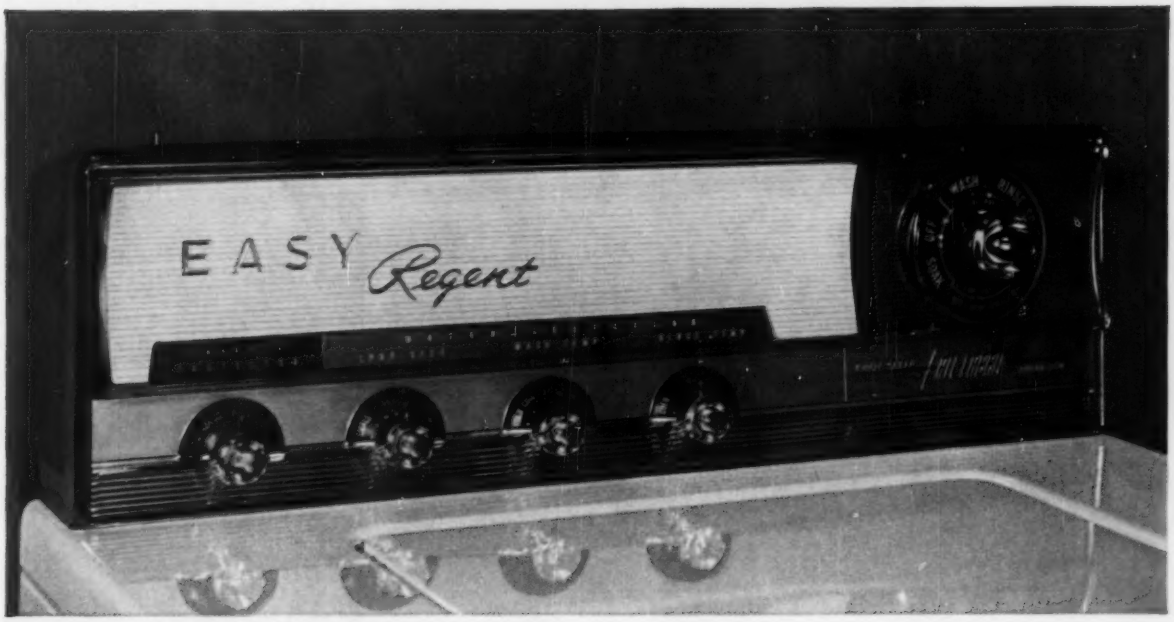
L·O·F GLASS FIBERS

L·O·F GLASS FIBERS COMPANY · TOLEDO 1, OHIO

Designed with

PLEXIGLAS

in mind



From side to side and top to bottom, the handsome control panel of this automatic washer is a single unit, molded of transparent PLEXIGLAS® acrylic plastic. The panel is lighted by concealed fluorescent lamps. Metallic effects, colors, letters and dial markings are achieved by decorating the back surface of the crystal-clear molding.

The use of PLEXIGLAS resulted in these advantages:

- Distinctive product identification, illumination, and control dials are combined in one transparent material.
- The water-white clarity of the molding gives depth and sparkle to the decorative treatment.
- The smooth, integral surface of the panel is easy to keep clean and gleaming.
- The durability of PLEXIGLAS and its resistance to discoloration maintain the quality appearance of the panel throughout the life of the machine.
- Manufacturing costs and parts inventory are reduced because there are fewer parts to be assembled.

Our design staff and technical representatives will be glad to tell you what PLEXIGLAS *molding powder can do for your product.*

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay East, Toronto, Ontario, Canada*

Chemicals for Industry

ROHM & HAAS COMPANY

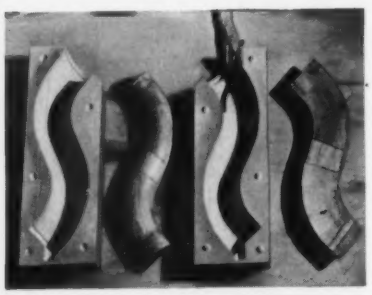
WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

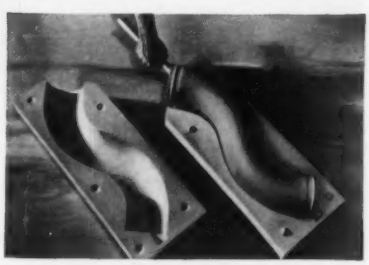
HOW BESTWALL® BREAKAWAY PLASTER CAN HELP YOU IMPROVE PRODUCTION OF HOLLOW, SEAMLESS PLASTIC PARTS

Malcor forms this aircraft duct easily, economically, to close tolerances around an expendable, dissolvable breakaway core

←Key step in the process at Malcor, plastic tooling, model and pattern maker, of Media, Pa. The Bestwall Breakaway Plaster core is easily dissolved out of the finished impregnated glass fibered cloth duct by simple immersion in hot water.



The part to be made is first modeled in wood. From this a plaster mold is cast. Malcor uses Bestwall Sunflower® Plaster here because it's a cool-setting plaster and won't generate enough heat to harm the wooden model.



Into this Sunflower Plaster mold Breakaway Plaster is poured to make a core. When the core is dry, impregnated glass fibered cloth is wrapped around it to form the aircraft duct. After curing, the piece is soaked in a washing tank, and the Breakaway core is easily dissolved—with no chance of malforming or damage to the finished duct. Mr. Malion, of Malcor, says, "Without Breakaway Plaster it would be virtually impossible to produce the variety of shapes we supply to the aircraft and automotive industries."

Instead of costly metal mandrels or hard-to-break plaster cores, try new Bestwall Breakaway Plaster for forming hollow, seamless plastic parts.

Unlike other materials, Breakaway Plaster can be *washed* out of the finished part with just hot water or steam. It is readily adaptable to the most intricate shapes. It will hold to a tolerance of ± .010 in. And it can help you form any hollow plastic part more quickly, easily and economically than has ever been possible before.

With the growing use of seamless plastic tubing, ducts and similar parts in the aviation, automotive and other industries, new Bestwall Breakaway Plaster is a material you should investigate thoroughly—and soon. Write or call the Bestwall Certain-teed Sales Office nearest you for complete information, and a demonstration, now.

INDUSTRIAL BESTWALL® GYPSUM PLASTERS

Bestwall Gypsum Company is the sole manufacturer of the widely accepted line of Densite® industrial gypsum plasters. Sales engineers are available through your nearest District Sales Office.

SOLD THROUGH

BESTWALL CERTAIN-TEED SALES CORPORATION

120 East Lancaster Avenue, Ardmore, Pa.

EXPORT DEPARTMENT: 100 East 42nd St., New York 17, N.Y.

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CLEVELAND, OHIO	EAST ST. LOUIS, ILL.	NIAGARA FALLS, N.Y.	WILMINGTON, DEL.

THE NATCO 400

a 27 oz. crisper every 45 seconds

Natco research is bringing to you the highest production in plastics yet! It's the new Natco 400 . . . the 28 oz. injection machine that combines all the features you've wished for . . . fast ram speeds . . . accurate temperature, pressure and speed controls . . . big platens with long stroke and daylight . . . and a big leakproof heating chamber with more plasticizing capacity than you can use! And that's not all.

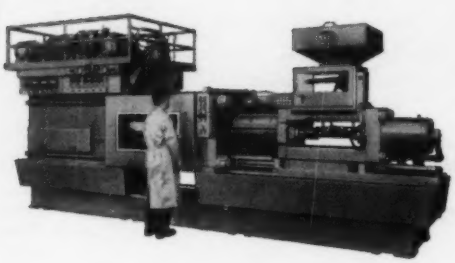
Check these Natco "firsts":

1. *Dual voltage heating.*
2. *Adjustable two speed injection.*
3. *Heating band signal lights.*
4. *Plug-in bands . . . timers . . . pyrometers.*
5. *Total elimination of big operating valves.*
6. *Instantaneous clamp pressure build-up. . . no delay.*

This 27 oz. polystyrene refrigerator crisper drawer is typical of large "single feed" shots possible with the new Natco 400. With "stuffing", the Natco 400 will "shoot" up to 40 ounces of butyrate.

Yes, you get more for your money with a Natco, and its new "valveless" closed circuit hydraulic system is positively shockless . . . eliminating those costly shut downs required to fix hydraulic leaks, solenoid burn outs, pump failures, and the multitude of breakdowns directly caused by hydraulic shock conditions.

One look at the new Natco will convince you it's a basic new scientific approach to lower injection molding costs. Machine sizes range from 16 to 85 ounces. Make a date to inspect the new Natco today!



Ask for free copy of Bulletin 4001 describing the new Natco 400.

NATCO

PLASTICS MACHINERY DIVISION

National Automatic Tool Co., Inc. Richmond, Indiana

FOR OVER FIFTY YEARS, DESIGNERS AND BUILDERS OF AUTOMATIC PRODUCTION MACHINERY

Diamond calcium carbonate fillers do more than save money

Sure, you can shave your costs* by filling glass-reinforced polyester resins with precipitated calcium carbonates. But just as important—in a quality-demanding market—is the fact that DIAMOND fillers help turn out products with these improved properties:

Smooth surfaces

Surfaces of *filled* reinforced polyesters are definitely better than those that aren't filled. Glass fibers are hidden. Deep cracks in resin rich areas are eliminated.

Controlled viscosity

Unfilled resin tends to flow from between closed match dies. You waste resin. Filled resin, because of its higher viscosity, stays within the mold's confines. Using the proper DIAMOND filler, you can control the viscosity and give the resin a body most suitable for the operations involved.

Decreased shrinkage

Fillers greatly reduce the shrinkage occurring during polymerization.

Greater wet strength

After immersion in water for seven days, filled polyesters show less loss in physical properties than unfilled ones do.

More even cooling rate

Polyester resin cools five to six times faster than glass fibers. This makes the fiber pull away from the resin, particularly at the surface. You get a surface that's difficult to paint. A precipitated calcium carbonate helps the resin mix and the glass fibers cool at a more even rate. The surface is smoother, easier to paint.

These improved properties reduce rejects and eliminate "touching up."

What fillers? DIAMOND suggests these four:

Surfex® MM—Particle size: 1 to 5 microns. Resin coated. Oil absorption 20-22 cc per 100 grams. Maintains low viscosity for a given filler concentration. Wetted very easily by resin.

Kalite®—Particle size: about 1 micron. Oil absorption 28-32 cc per 100 grams. Recommended for draw work.

Suspenso®—Particle size: 1 to 5 microns. White. Uncoated. Oil absorption 20-22 cc per 100 grams. Use in applications where pot life is critical. Eliminates crazing in resin rich areas.

Multifex® MM—Particle size: .05-.06 micron. Uncoated. Gives reinforced plastic a smooth white, nonporous finish. Requires less extra work after molding. Little buffing required.

*Your nearby DIAMOND sales representative can show you money-saving formulas and detailed cost comparisons. Or ask for Bulletin No. 8. Write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

Sales Offices: New York, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, Houston.

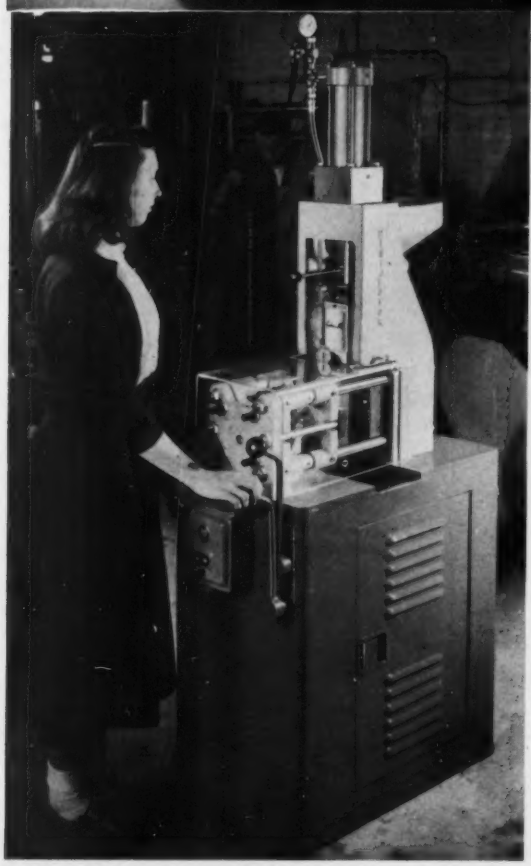
Diamond Distributors: Carmona & Hawxhurst, San Francisco; Dorsett & Jackson, Los Angeles; Van Waters and Rogers, Inc., Seattle and Portland, U.S.A.; Harrisons & Crosfield (Canada), Ltd.

Diamond Chemicals

MINI-JECTOR®

TRADE MARK

PLASTIC INJECTION MOLDING MACHINES



"Super-Hornet" Power-Operated, Lever-Controlled
One of many models in "Hornet" and "Wasp" Series to suit your needs.

MORE VARIETY at LOWER COST!

Saved: Thousands of dollars in mold costs with versatile, economical MINI-JECTOR. Eliminate "big press" high-per-piece tooling charges!

The more variety, the bigger the savings! Flexible, efficient, MINI-JECTOR Plastic Injection Molding Machines fill your need for low-cost development and production of fast-changing varieties of small molded plastic items. Savings begin with low initial investment of machine (under $1,000) and mold-blanks (as low as $29.50). Even more important are the bigger savings in time, trouble and money developing and producing "varieties" of different items by eliminating complex, costly big-press tooling where not required. MINI-JECTOR solves your tricky "insert" molding, too. Compact, simple to operate. Mold capacity 1/3 oz. to 1 oz., all thermoplastics and Nylon. Lever and push-button control models, air or hydraulic power to fit your facilities. Users claim MINI-JECTORS pay for themselves many times over in *savings alone.*

Bring your requirements to Newbury! Our engineers can help you select the model MINI-JECTOR to develop and produce your small (up to 1 oz.) plastic items at lower cost than previous methods.

Write for Catalog today! "Tell-all" booklet, completely illustrated, shows entire line of MINI-JECTOR Plastic Injection Molding Machines and accessories. Learn how MINI-JECTOR adds new flexibility and economy to your plant operations.

NEWBURY INDUSTRIES Inc.

Box 386, Newbury, Ohio

"Plastic Injection Molding Machines up to One Ounce Capacity"

Get jetness at low cost with the "ALL-PLASTIC" BLACK

Columbian's

COWAXBLAK-CB

30% DISPERSION OF SUPERBA® (carbon black)

in Resinous Chlorinated Paraffin

- Versatile – Cowaxblaks are compatible with all the important plastic systems.
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- Cleanliness... dustless dispersion keeps plant clean-up and contamination to a minimum.
- Economy... goes further than carbon black used with ordinary dispersion methods.

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COLUMBIAN CARBON COMPANY

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WHY CYCOLAC®

New HIGH-IMPACT THERMOPLASTIC RESIN

...in ZIPEES® *-the world's safest, lightest, strongest roller skates?*

the answer is simple

The Manning Manufacturing Corporation chose CYCOLAC for their roller skates because CYCOLAC gave them the light weight, non-corroding and non-rusting properties their specifications demanded: plus the sturdy, rigid toughness and high impact strength a roller skate must have. CYCOLAC's bright glossy colors, excellent moldability and non-brittle nature, even at very low temperature, made the selection of CYCOLAC an ideal choice.

CYCOLAC can also work wonders for you. This family of single uniform resins is permanently thermoplastic, permitting fast molding, calendering and extruding. It is economical to form from press-polished sheets by vacuum, air-pressure, or mechanical methods over inexpensive molds of wood, plaster, aluminum, etc.

molders . . . extruders . . . calenderers . . . *Compare these added CYCOLAC BENEFITS!*

In addition to CYCOLAC's unique balance of properties, which makes it ideal for hundreds of end-use products, you get these added benefits!

- No breakage in processing.
- No breakage in assembling and finishing operations.
- Better adherence to dimensions and tolerances.
- Readily lacquered, enameled or printed. Decals apply easily.
- Greater uniformity of processing.
- Lower shipping costs.
- Light weight means more parts per pound.

Write for technical literature today!

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Marbon CHEMICAL

SYNTHETIC RESINS

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also represented by:

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BW

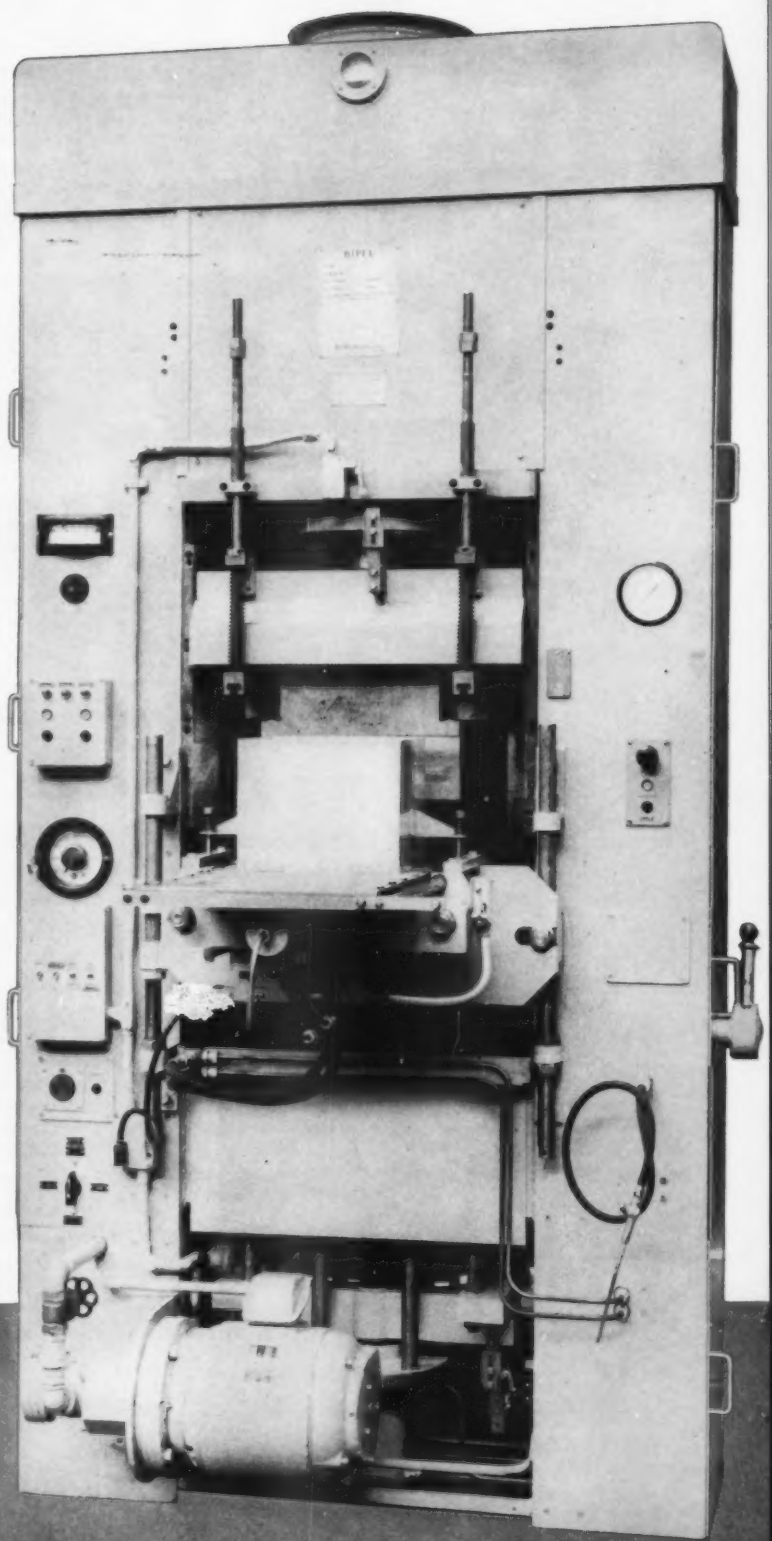
Marbon®

BIPEL AUTOMATIC

FASTER CYCLES IN HALF THE SPACE!

Brand new from Bipel . . . faster *fully automatic* operation, in half the usual floor space!

Feeding and stripping tables are designed to permit full length strokes from short stroke cylinders with no overhang beyond the ends of the stripping and loading plates. The cycle is remarkably fast, yet plates are accelerated and decelerated gently.



BIPEL *Automatic*

COMPRESSION TRANSFER PRESS

For added convenience all automatic units can be swung clear to the side, permitting the mold setter to stand right up to the press. These units may be adjusted vertically to suit tool height. Top or bottom ejection may be selected with a single plug-in. Operation may be changed from automatic to semi-automatic, or manual at the flick of a switch.

More economical to buy and easier to maintain, these new BIPEL automatic presses are available in two models, permitting infinitely variable pressures up to 71 or 168 tons maximum. For speed, economy and complete flexibility be sure to see BIPEL, first!

DEMONSTRATIONS AND SERVICE FACILITIES AT TIVERTON.

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3571 Main Road, Tiverton, R. I.

. . . this is **BIPEL**

Moulding machines thruout the plastics industry are now being installed on Air-Loc® 4·17·4

the VINYL vibration dampening mount that provides permanent precision alignment

H.P.M. 87,000 lb. injection moulding machine installed on 14 pieces of Air-Loc, each 8" x 18", spaced 47" on centers. Complete installation made without bolting or cementing machine to floor.

Air-Loc® 4·17·4 is the only Vinyl mount that gives you . . .

1. Permanent precision installation without bolting or cementing.
2. Complete resistance to oil, water, alkali, etc.
3. Easy precision shimming for quick leveling.
4. Low initial cost and no maintenance cost. (You can re-use Air-Loc mounts.)

Reduce transmitted noise and vibration from moulding machines with patented Air-Loc. Return the coupon for a free sample and complete information.

RETURN COUPON FOR A SAMPLE OF AIR-LOC AND COMPLETE INFORMATION.

AIR-LOC DIVISION CLARK, CUTLER, McDERMOTT CO., Franklin, Massachusetts

Please send a sample of Air-Loc for moulding machine installation:

Name..... (PLEASE PRINT) Title.....

Company .....

Address .....

City..... Zone..... State.....

No Boonton Customers on this Couch

Ulcers and the psychoanalyst's couch are said to be standard equipment for the modern, fast moving executive.

We wouldn't know for sure. We are just custom molders of plastics, located in the hills of Northern New Jersey, working with efficient, smooth running machinery and an operating crew who live, for the most part, just a few minutes drive away.

Sure we have troubles. We go looking for them by trying to do things that are hard to do.

You can note one item in the book—if any of our customers wind up on the couch in a reclining position, it won't be because their demands on us for plastic moldings got them down.

If the guy in the picture did flip his lid because of plastic molding troubles, we know just what the doctor would tell him to do—

Go see Boonton.

BOONTON MOLDING CO.
BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.)
Philadelphia Area—Pioneer 3-0315

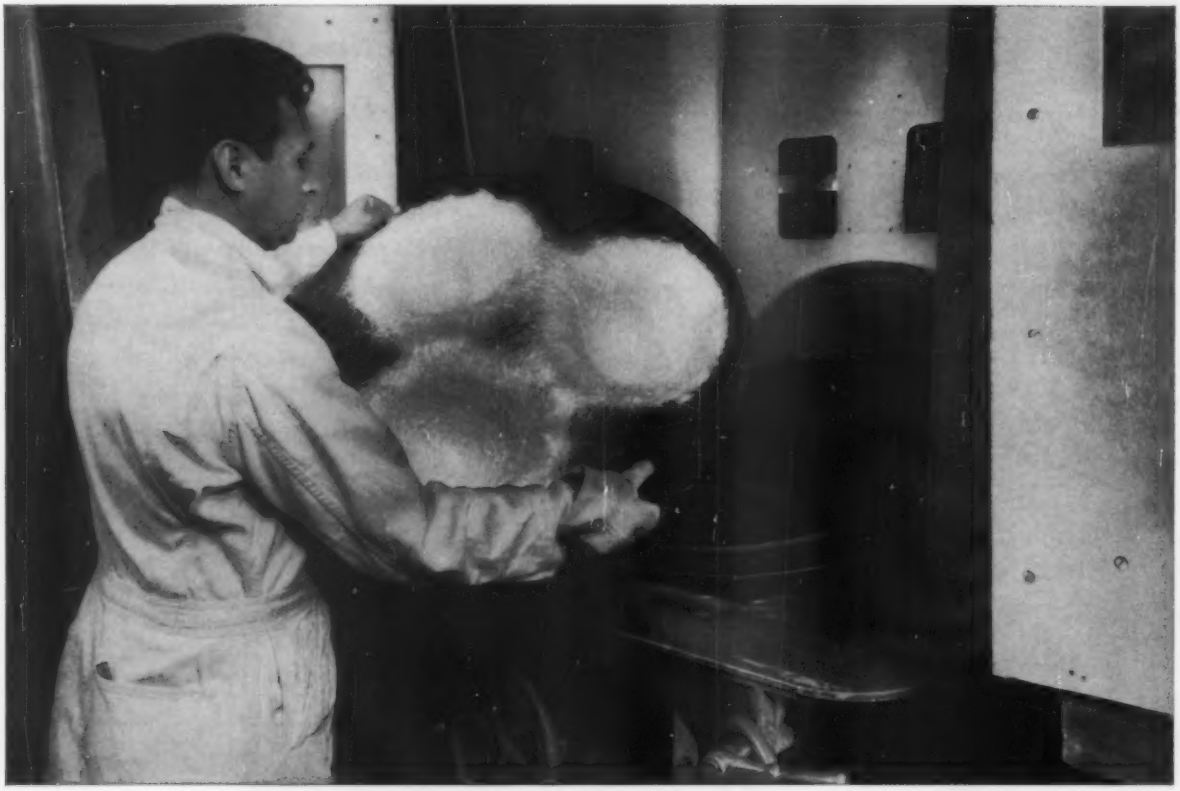
2,000-ton R. D. Wood Hydraulic Press for laminating and polishing plastics. Press has 10—4" openings, platen size 42"x83", and is of the completely self-contained type, including pumping unit for semi-automatic control of time, pressure and temperature. Press is equipped with hydraulic loading and unloading elevator. Send for complete details of this or other R. D. Wood Presses for the plastics industry, without obligation.

The most productive plants use R. D. Wood Presses

For proof, look at production records—and downtime for maintenance. Then watch an R. D. Wood Press at work. See for yourself the smooth, precise operation—the dependable performance—even under tough conditions. Finally, inspect an R. D. Wood Press up close. Notice the soundness of design, the excellence of materials, the scrupulous care given to each detail of construction. These are the reasons why R. D. Wood Presses are the standard of excellence throughout the plastics industry.

R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA



Here's how PITTSBURGH FIBER GLASS can help you make better laminated and molded products

1... through top-quality uniformity

Pittsburgh Fiber Glass, produced by the direct melt process under close control, is a top-quality, uniform reinforcement with exceptional strength, dimensional stability and dielectric strength . . . that is fire resistant, heat resistant and odorless.

2... with the right reinforcement for your needs

YARNS—supplied to weavers in any twist or ply in all standard sizes. Reliable uniformity of Pittsburgh Yarns has won its acceptance for use in cloth laminates for military applications.

ROVING—available in a variety of finishes and end counts. Custom wound for your requirements. Static-free Pittsburgh Roving makes pre-form operations easier and faster, produces better quality end products.

CHOPPED STRAND—supplied in lengths ¼" and up. Packaged for convenient handling. High uniform quality reduces percentage of rejects.

3... and technical assistance

You can arrange to have free trials made right in your own plant to show you how Pittsburgh Fiber Glass can help you produce better products. Write or call your nearest Pittsburgh Plate Glass sales office or our main office in Pittsburgh.

Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pa.

PITTSBURGH FIBER GLASS IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

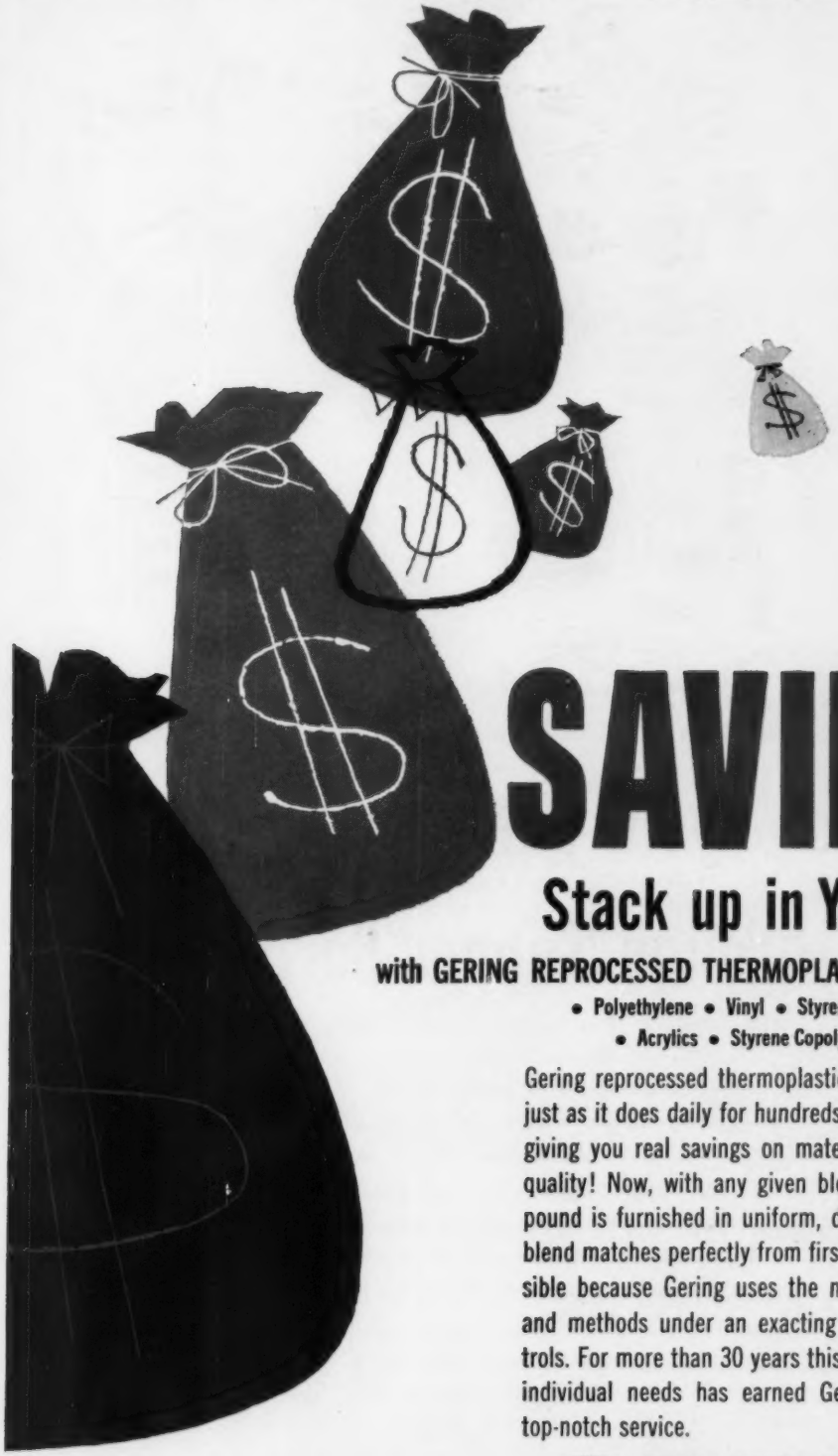
Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh and St. Louis

FIBER PPG GLASS

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS

PITTSBURGH PLATE GLASS COMPANY

GERING—FIRST CHOICE FOR QUALITY AND CUSTOM TAILORED MOLDING COMPOUNDS



SAVINGS

Stack up in Your Favor

with GERING REPROCESSED THERMOPLASTIC MOLDING COMPOUNDS

• Polyethylene • Vinyl • Styrene • Acetate • Nylon
• Acrylics • Styrene Copolymers • Butyrate

Gering reprocessed thermoplastics can cut your costs—just as it does daily for hundreds of leading molders—by giving you real savings on materials without sacrificing quality! Now, with any given blend, your molding compound is furnished in uniform, dust-free pellets and the blend matches perfectly from first bag to last. That's possible because Gering uses the most modern equipment and methods under an exacting system of quality controls. For more than 30 years this response to customers' individual needs has earned Gering its reputation for top-notch service.

Special offerings of high quality reprocessed thermoplastics are announced through a new bulletin service. We'll be glad to send these money-saving notices to you. Just send us your name.

GERING
Molding Powders

Gering Products, Inc., North 7th St. & Monroe Ave., Kenilworth, N.J. • Sales Offices: 5143 Diversey Ave., Chicago 39, Ill. • 424 Chevy Chase Rd., Mansfield, Ohio

Baby Playthings

Toddler Toys

Housewares

Modern House Fittings

Outdoor Living Aids

Containers & Packaging

Symbols of your potential through Tupper Corporation

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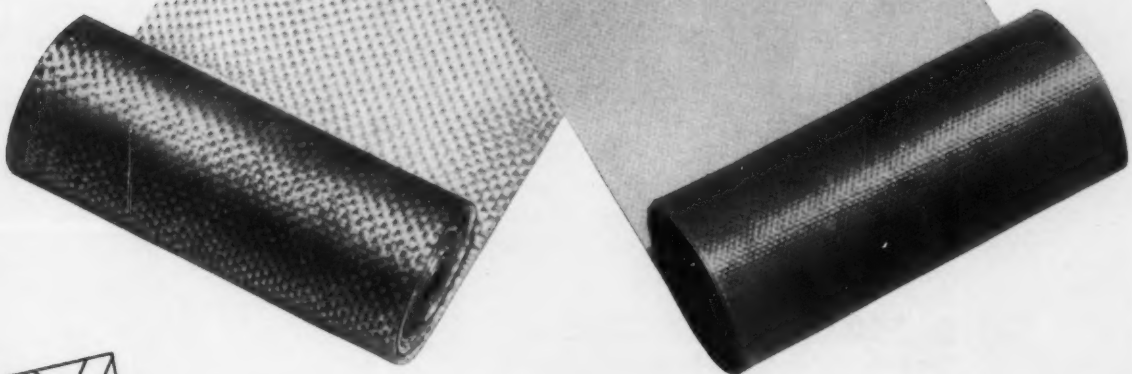

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Trevarno
GLASS FABRICS

COAST MANUFACTURING AND SUPPLY COMPANY
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Please send me data on materials for the temperature ranges or resin systems I have checked below:

☐ 60°F to 160°F	☐ Phenolic	☐ Fabric
☐ 160°F to 750°F	☐ Epoxy	☐ Chopped Fabric
☐ 800°F to 1500°F	☐ Silicone	
☐ 1500°F to 10,000°F	☐ Polyester	

Name_____

Company_____

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City_____ State_____

4065

THE FELLOWS "12-350" leads the

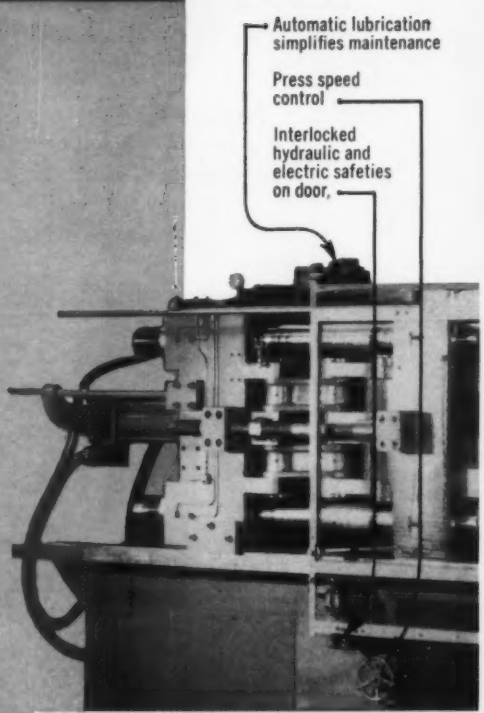
- **FAST** — For the first time, here is an intermediate size machine that cycles *faster* than many smaller machines for those large area, thin wall parts! The "12-350" dry cycles at 700 cycles per hour.

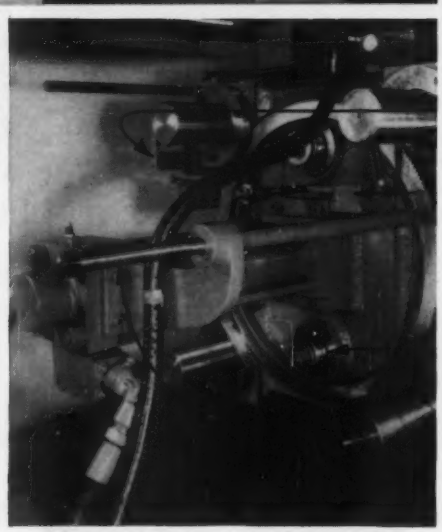
- **HIGH CAPACITY** — Make shots up to 20 ounces — 33 cubic inches — with the optional Pre-Pac device which double-strokes the plunger during press dwell.

- **FULLY AUTOMATIC** — One man can supervise three or more machines while they operate themselves! Precision controls are grouped for easy setting and checking. Optional equipment includes Recycle Timer, Air-Blast, Dual Injection Pressure Control, Low-Pressure Mold Closing Safety Device, and Counter.

- **EASY SET-UP** — Press retracts from the heating cylinder for easy hot-end set-up and purging. Mold opens 14". Mold height and clamping adjustment set easily and accurately through a single control shaft.

- **AND MORE FEATURES—** The 12-350 takes mold bases up to 20" by 33" with a 14" draw . . . toggles exert clamping pressure of 350 tons . . . ball joint adapter for injection nozzle simplifies alignment of sprue bushing and heating cylinder . . . hydraulic and electric interlocks on safety doors . . . and many other Fellows high-production features!


Automatic lubrication simplifies maintenance
Press speed control
Interlocked hydraulic and electric safeties on door.



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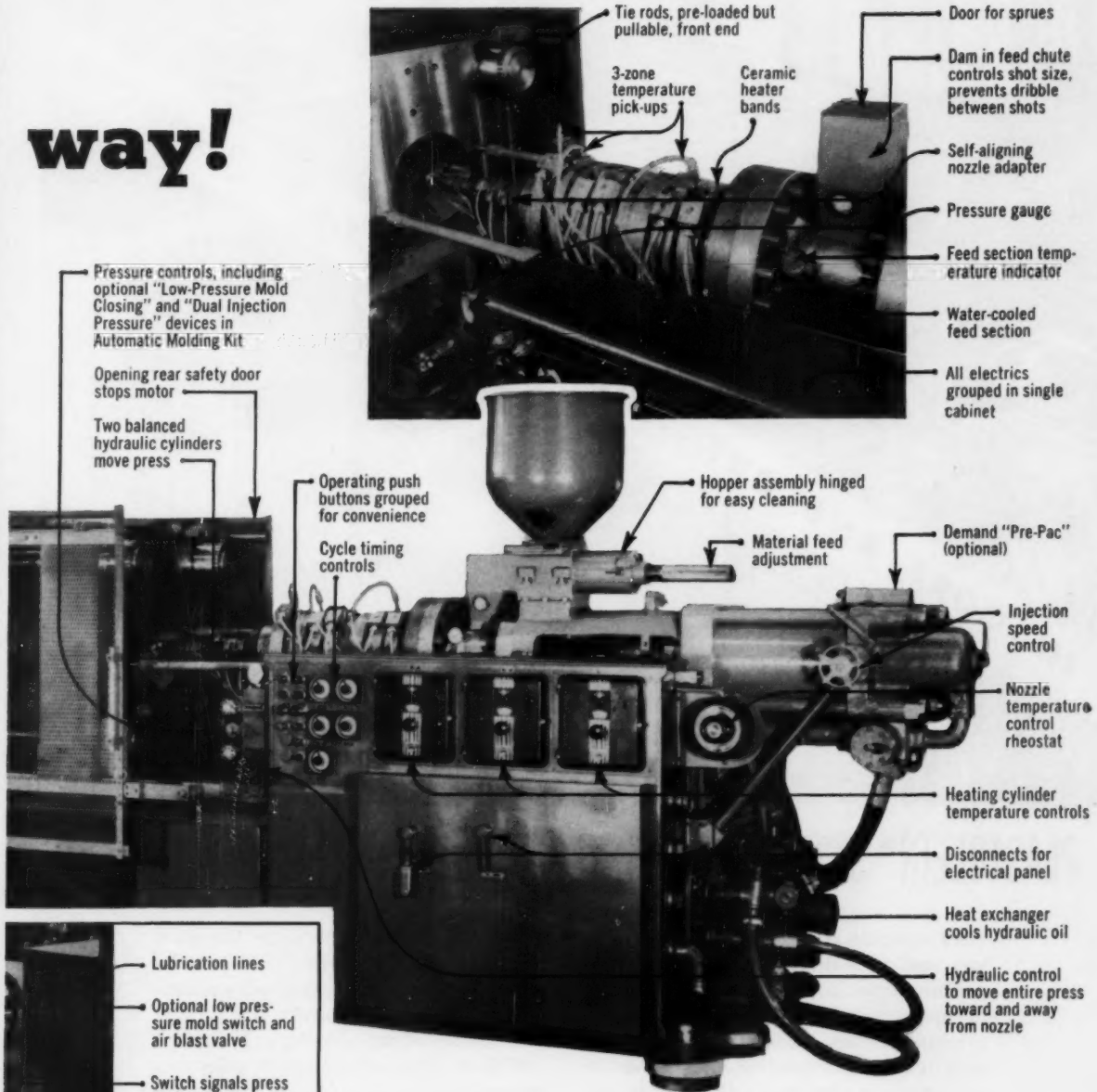
THE FELLOWS GEAR SHAPER COMPANY
Plastics Machine Division

Head Office and Export Department: Springfield, Vermont • Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.

way!


Tie rods, pre-loaded but pullable, front end
3-zone temperature pick-ups
Ceramic heater bands
Door for sprues
Dam in feed chute controls shot size, prevents dribble between shots
Self-aligning nozzle adapter
Pressure gauge
Feed section temperature indicator
Water-cooled feed section
All electrics grouped in single cabinet
Pressure controls, including optional "Low-Pressure Mold Closing" and "Dual Injection Pressure" devices in Automatic Molding Kit
Opening rear safety door stops motor
Two balanced hydraulic cylinders move press
Operating push buttons grouped for convenience
Cycle timing controls
Hopper assembly hinged for easy cleaning
Material feed adjustment
Demand "Pre-Pac" (optional)
Injection speed control
Nozzle temperature control rheostat
Heating cylinder temperature controls
Disconnects for electrical panel
Heat exchanger cools hydraulic oil
Hydraulic control to move entire press toward and away from nozzle
Lubrication lines
Optional low pressure mold switch and air blast valve
Switch signals press is closed and starts injection
Adjustable side knock-out (optional)
Heavy duty trunnion bars for positive press alignment on opening and closing
One-point die height adjustment

Fellows

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With all these advantages to gain, why not try Plastolein 9720 in your vinyl upholstery—or in any formulation where extreme permanence is essential.

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Dept. F-10 Carew Tower, Cincinnati 2, Ohio
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MODERN PLASTICS

Don't miss...

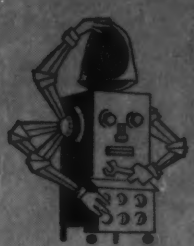
Every plastics user everywhere is today affected by the current of world trade in plastics. Between 1929 and 1956 this trade increased from 35 million pounds to over a billion pounds. Four countries—the United States, West Germany, Great Britain, and Italy—sell about 85% of all exports. But an important and new part of world trade is the cross-licensing of patents and know-how from country to country and the establishment of subsidiary plastics producers by investment abroad.

Here is the first definitive analysis of the present course and probable future trends of . . . "World trade in plastics," p. 101.

Who makes polyethylene, polyvinyl chloride, and styrene polymers and where? World maps accompanied by lists of producers are included for ready reference. See pp. 104 to 109.

Did you miss the British Plastics Exposition? At this, a truly international exhibition, several important new developments were presented. See "Report on the Fourth British Plastics Exhibition," p. 113.

Interested in full automation in molding? For the first time automatic feeding of molding material from "packages" of over a ton each is combined with automatic preheating of molding powder and automatic ejection of molded parts. Result: a new high in efficiency and production economy. See "Automatic molding of automotive components," p. 120.

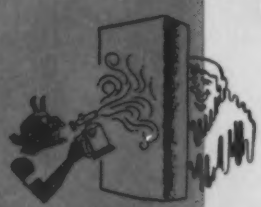


Needed: Lower-cost mold cavities. Here is a method which uses a refractory mixture for making precision castings, avoiding necessity for an expendable pattern. See "Cast mold cavities," p. 147.

Plastics furniture drawers have been an ambition of this industry for years. Stymies were: lethargy in the furniture industry, fantastic complications in sizes and styles of drawers, lack of capital for expensive tools. Now, these stymies have been licked and over 1.5 million pounds of plastics will be used in drawers this year, with a huge increase expected in 1958. Here is a complete picture of the market, the problems, the distribution methods, with a chart showing plastics drawers presently being offered. See "Plastics drawers," p. 114.

Why the boom in plastics housewares? Now a business using over 150 million lb. of materials a year, the plastics housewares industry is growing fast, outstripping all predictions because of quality, proper application of materials, color, and ingenious design. See "Housewares=75,000 tons of plastics+," p. 110.

Potential for rigid foams is growing every day. Ten different plastics foams are involved in a huge range of applications from water ski cores through refrigeration to home construction. This, the second of two articles on plastics foams, tells the whole story. See "Rigid foams," p. 124.



Strength where strength is needed is now possible in design for reinforced plastics by the use of directionally reinforced epoxies. The first of a series of articles shows that these materials may be so accurately designed for and engineered that service strengths are close to laboratory values. See "Directionally reinforced plastics," p. 133.

Watch for... a new series of articles on the economics of extrusion, written for the layman . . . a survey of plastics in the auto trim field . . . a review of recent developments in plastisols . . . an article on hard resins in optical lenses . . . an analysis of the use of plastics in trays and tote boxes . . . a comprehensive story on how to make and use reinforced phenolic premixes . . . an article on a new device which automatically loads large numbers of inserts into horizontal compression molds.

World trade in plastics

By Erich Gansmuller

*and Robert W. Crawford**

Reader reaction to our series "Wide world of plastics" which began May 1956 and ended January 1957 indicated that the world picture of the plastics industries is important to material makers, processors, and end users alike.

Since that series of articles appeared, there have been a number of developments in American investment in foreign plastics industries, in know-how agreements, and in market shifts that made it imperative for your editors to present a composite picture of foreign trade in plastics throughout the free world.

Months of research have gone into this project, the first of its kind ever published.

Plastics materials are used today in almost all economies of the world. This widespread acceptance has generated a global trade in these materials which has reached substantial volume in the past several years. How significant is this world trade? Which countries are the main participants? What are the present and possible future trends? What obstacles exist to trading freely? What about foreign competition? It is the purpose of this article to answer some of these broad questions and to provide a rounded picture of present world trade in plastics raw materials.

World trade increasing

Between 1929 and 1935, world exports ran as low as 35 and 48 million lb., respectively. Since the end of World War II, however, and especially since 1950, world trade in plastics raw materials has been rising fantastically. By 1950 total exports had reached 253 million lb.; the Korean conflict boosted the volume to a record level of 395 million lb. in 1951; and in 1952 a minor recession decreased the same figure to 345 million pounds. From 1953 on the

* See p. 102.

Table I—World exports of plastics raw materials 1951-1956 (in millions of lb.)

	1951	1952	1953	1954	1955	1956
United States	165.0	139.0	158.0	219.2	291.3	390.0
West Germany	56.4	52.5	92.0	136.1	192.1	240.0
Great Britain	119.0	93.0	126.6	157.0	187.3	219.0
Italy	4.3	6.8	14.8	30.9	65.0	—
Canada	—	15.6	31.4	33.9	39.4	—
France	7.5	3.0	7.3	17.6	21.4	—
Netherlands	19.0	15.0	27.0	12.4*	13.9*	—
Switzerland	6.6	5.7	8.0	10.1	10.9	—
Japan	4.5	3.9	3.6	3.6**	6.5**	—
Other	12.8	10.5	14.3	14.2	22.2	—
Total	*395.0*	*345.0*	*483.0*	*635.0*	*850.0*	*1190.0* (estimate)

* Vinyls restricted. ** Celluloid restricted.

expansion has been rapid and continuous; estimates for 1956[1] indicate a level of more than 1000 million pounds.

Four countries—the United States, West Germany, Great Britain, and Italy—sell roughly 85% of all exports. In absolute amounts, sales abroad increased for all four countries, but West Germany and Italy also expanded their relative share of total world trade. Great Britain and the United States, on the other hand, experienced a decline in their percentage shares in recent years. See Tables I, above and II, below.

United States

The United States is not only the largest producer of plastics raw materials[2], but is also the largest exporter. It is significant that American exports as a percentage of production have continuously increased in the past few years. In 1951 exports were only 6.9% of production; by 1956 the same figure amounted to almost 10% (6 to 8 million lb. of vulcanized fibre exports are not included).

The export classification "resins NEC" (Not elsewhere classified) is today by far the largest group in American plastics raw materials exports. The clue to the meteoric rise from 18 million lb. in 1951 to a total volume of not less than 163.7 million lb. in 1956 is polyethylene. In 1956, some 129 million lb. of polyethylene was exported. Japan was the largest customer with an estimated 24 million lb.; new Japanese import restrictions arising from the present

[1] Statistics for 1956 were still incomplete when this article was written.
[2] For 1956, U. S. production amounted to roughly 60% of the world total.

Table II—Exports as percentage of total world exports

	1951	1952	1953	1954	1955	1956
United States	41.8	40.3	32.8	34.5	34.3	35.8
West Germany	14.3	15.2	19.0	21.4	22.6	22.1
Great Britain	30.1	27.0	26.2	24.7	22.0	20.1
Italy	1.1	2.0	3.1	4.9	7.6	8.6
Other	12.7	15.5	18.9	14.5	13.5	13.4
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

The Authors

Gansmuller

Erich Gansmuller co-author with Mr. Crawford (see below) of the accompanying article, was born and raised in Europe. After two years at the University of Vienna, Mr. Gansmuller won a Fulbright Scholarship to Union College where he received his Bachelor's degree in Liberal Arts in 1954. He consecutively received his master's degree in Economics from Colgate University, worked in plastics market research for E. I. du Pont de Nemours & Co., and is presently finishing his studies for the Master of Business Administration at the Wharton School of Finance and Commerce (University of Pennsylvania), where he has also been teaching International Commerce.

Crawford

Robert W. Crawford, business research manager for Monsanto's Plastic Div., since 1951, received his B. A. degree in mathematics from Amherst College in 1937 and, in 1939, his M.B.A. degree from Harvard Business School. He is a Phi Beta Kappa, and graduated magna cum laude.

Upon graduation from Harvard, Mr. Crawford joined Monsanto as sales trainee.

Subsequent promotions include product development, technical service, sales research manager and business research manager.

He is a member of the following organizations: Operations Research Society of America; Society for the Advancement of Management; Institute of Management Science; American Economic Association; Econometric Society; American Chemical Society; American Marketing Association; Chemical Market Research Association; Society of Plastics Engineers; American Statistical Association and Delta Kappa Epsilon (social fraternity).

Table III: German exports and imports—1956 (in thousands of lb.)

	Exports	*Imports*
Polymerization products	162,926	27,493
Condensation products	48,436	9,686
Cellulosics products	28,420	9,903
Total	*239,782*	*47,081*

Main customers: (cellulosics excluded)

France	17,000	Netherlands	16,000	Austria	13,000
Switzerland	17,000	Italy	15,000	Gr. Britain	12,000
Sweden	17,000	Belgium	14,000	U.S.A.	6,000

foreign exchange shortage, however, will have a strong adverse affect on the market for this and probably the first part of next year. Furthermore, construction of polyethylene capacity by American producers in Japan will change future requirements. France was the second largest customer with 20 million lb. and Canada was third with over 19 million pounds. West Germany imported over 7 million lb., Sweden 7 million lb., Belgium 6 million lb., and Great Britain 6 million pounds. Further exports of polyethylene reached almost every country of the free world.

The difference between polyethylene and total "resins NEC" exports (approximately 33.5 million lb.) is unfortunately not broken down by individual groups. It consists of such old plastics "work-horses" as acrylics, aniline formaldehyde, furfural, and cold molded resins, as well as some rather recent materials, such as nylon, fluorocarbons, epoxies, silicones, and isocyanates. Recent increases in exports are predominantly in the latter group.

Polystyrene is today the second largest export resin with a record level of almost 58 million lb. in 1956. Sales have risen rapidly in recent years and at least the near future for this resin group, especially high-impact polystyrene, looks bright. Sales to Europe and Scandinavia as a whole have declined due to strong price and quality competition from Canada and Italy, but such countries as France and the Netherlands still purchase over 4 million lb. annually. The rest of the free world—Central America, South America, and the Far East with Japan in particular, provide an increasing market. Considering its size,

Table IV: British exports and imports—1956 (in thousands of lb.)

	Exports
Liquid and solid resins	
Phenol and cresol formaldehyde	7,010
Urea formaldehyde	30,269
Vinyl: unplasticized	18,327
plasticized	11,890
other	20,502
Molding powders	
Cellulose acetate	6,184
Phenol and cresol formaldehyde	3,105
Polystyrene	23,872
Urea formaldehyde	15,169
Other	40,976
Rods, sheets, tubes, film	
Acrylic	13,281
Cellulose acetate	902
Celluloid	532
PVC	4,631
Total exports	219,000
Total imports	51,872

Main customers:

India	18,768	Union of S. Africa	13,219
Australia	18,485	Sweden	11,751
France	15,141	United States	5,115
Netherlands	14,442		

Polyethylene

NORTH AMERICA

United States

Allied Chemical and Dye Corp.
Semet-Solvay Petrochemical Div.
Tonawanda, N. Y.

*Bakelite Corp.
Div. of Union Carbide Corp.
Institute, W. Va.

Bakelite Corp.
Div. of Union Carbide Corp.
Charleston, W. Va.

Bakelite Corp.
Div. of Union Carbide Corp.
Sea Drift, Texas

Bakelite Corp.
Div. of Union Carbide Corp.
Texas City, Texas

Bakelite Corp.
Div. of Union Carbide Corp.
Torrance, Calif.

Celanese Corp.
San Jacinto, Texas

Dow Chemical Co.
Texas Div.
Freeport and Velasco, Texas

*E. I. du Pont de Nemours Co., Inc.
Beaumont, Texas

E. I. du Pont de Nemours Co., Inc.
Orange, Texas

Eastman Chemical Products Inc.
Longview, Texas.
(Subsidiary of Eastman Kodak Co.)

*Goodrich Gulf Inc.
Orange, Tex.

W. R. Grace and Co.
Polymer Chemicals Div.
Baton Rouge, La.

Hercules Powder Co.
Parlin, N. J.

*Koppers Brea
Brea, Calif.

Koppers Co., Inc.
Kobuta, Pa.

Koppers Co., Inc.
Port Arthur, Texas

Koppers Co., Inc.
Woodbridge, N. J.

Monsanto Chemical Co.
Texas City, Texas

National Petro-Chemical Corp., Div.
National Distillers Products Corp.
Tuscola, Ill.

Phillips Chemical Co.
Adams Terminal, Texas

Phillips Petroleum Co.
Bartlesville, Okla.

Spencer Chemical Co.
Orange, Texas

*Standard Oil of Indiana
Whiting, Ind.

Manufacturers[1]

Canada

Canadian Industries Ltd.
Edmonton, Alberta
(Owned by I.C.I. and Du Pont)

Union Carbide of Canada Ltd.
Montreal East

SOUTH AMERICA

Brazil

*Fonbras
Sao Paulo
(Jointly owned by W. R. Grace and Farbwerke Hoechst A. G. of Germany)

Industrias Quimicas Electro Cloro, S.A.
(Subsidiary of Solvay and Cie of Brussels)

*Union Carbide do Brazil
Cuba, Tao

Mexico

Petroleos Mexicanos
Atzcapotzalco

EUROPE

Belgium

*Societe Solvay et Cie

England

Imperial Chemical Industries
London

*Monsanto Chemicals Ltd.
Fawley, Hampshire

Shell Chemical Co. Ltd.
Partington, Cheshire

France

*Compagnie Francaise de Rafinage

Ethylene Plastique of Mazingarbe
Pas-de-Calais
(Associated with Pechiney)

*Societe Kuhlman
St. Gobain

*Societe des Usines Chimiques
Rhone—Poulenc

Germany

Badische Anilin und
Sodafabrik (BASF)
Wesseling/Rhine

Bergwerksgesellschaft
Hibernia, Herne

Chemische Werk Huls
Marl Kreis Recklinghausen

Farbwerke Hoechst
Hoechst, Frankfurt/Main

Kohle-Oel-Chemie A.G.
Gelsenkirchen
(Owned by Deutsche Erdvel [Hamburg] Mannesmann [Dusseldorf] and Farbwerke Hoechst [Frankfurt])

Ruhr Chemie A.G.
Oberhausen—Holten

Rheinische-Olefinwerke G.m.b.H.
Wesseling
(Owned by BASF and Deutsche Shell)

Italy

*Celene
(Formed by Union Carbide and Edison Co. of Italy)

Montecatini
Milan

*Solvay and Phillips

Netherlands

*Netherlands State Coal Mines
Beek

Scotland

Bakelite Div.
Union Carbide Ltd.

Grangemouth
British Hydrocarbon Chemicals
Grangemouth
(Owned by the Distillers Co. Ltd. and British Petroleum Co. Ltd.)

ASIA

India

Alkali and Chemical Corp. of
India Ltd.
(Associate of Imperial
Chemical Industries)

Japan

*Furukawa Industrial

Mitsubishi Petrochemical Co.

Mitsui Petrochemical Co.
Nagoya City

*Showka Denko
Kanose

Sumitomo Chemical Co.
Kikumoto, Niihama City

AUSTRALIA

*Imperial Chemical Industries
(Australia and New Zealand) Ltd.
Sydney

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*Not in Production End 1957.

[1]If classified by the Standard Industrial Classification manual, all plants on the maps opposite and on the following four pages are in Industry 2823—Plastics Materials and Elastomers Except Synthetic Rubber. These are the plants for the manufacture of plastics raw materials. Excluded are plants in Industry 3971—Fabricated Plastics Products. Also excluded are plants in Industry 2829—Industrial Organic Chemicals Not Elsewhere Classified, which includes monomers and other raw materials for the plastics industry.

Hong Kong is buying a fair amount of polystyrene as well as other resins. It is a Far Eastern molding and extrusion center, and rumors have it that its products even cut into the domestic market of American processors. Market trends are not always clear and lasting, since U. S.-owned plants abroad often buy temporarily from the parent company to bridge shortages or emergencies. With several American companies establishing further foreign operations, it is rather questionable whether favorable trends will continue for long. For example, last year Dow and Monsanto established plants in Japan, which country received 25% of polystyrene exports during 1956.

Vinyls, once the largest export resin group, are today third with roughly 50 million lb. in 1956. Uncompounded vinyl and vinyl copolymer resins were sold at a volume of nearly 34 million lb., with Canada alone taking 15 million pounds. Great Britain bought over 6 million lb., partially because a large British vinyl plant was out of commission. Japan with 2 million lb. and Mexico, as well as Cuba, with over 1 million lb. each were other major customers. Vinyl and vinyl copolymer exports reached 13.7 million pounds. Again Canada was top customer with 2.5 million lb. of imports. Korea was second with 18 million pounds. These imports are almost exclusively used for wire coating purposes. Mexico, Brazil, Argentina, Colombia, the Union of South Africa, and New Zealand bought well over half a million lb. each. Over 2 million lb. of semi-finished vinyl materials went to 32 different countries.

Cellulosics, phenolics, and amino resins are of considerably less importance, with nearly 20 million lbs. each. Each group has shown little change in volume over recent years; the market area, however, is shifting away from Europe to Canada, Mexico, South America, and the Far East.

Information on plastics raw

Styrene Resin

NORTH AMERICA

United States

Astra (Solar) Chemical Co.
Leominster, Mass.

American Cyanamid Co.
Wallingford, Conn.

Bakelite Corp.
Div. of Union Carbide Corp.
Bound Brook, N. J.

Bakelite Corp.
Div. of Union Carbide Corp.
Marietta, Ohio

The Borden Co., Polyco Dept.
Peabody, Mass.

Chemical Process Co.
Redwood City, Calif.

Dewey and Almy Chemical Co.
Div. W. R. Grace and Co.
Cambridge, Mass.

Dow Chemical Co.
Western Div.
Pittsburgh, Calif.

Dow Chemical Co.
Western Div.
Torrance, Calif.

Dow Chemical Co.
Allyn's Point Div.
Allyn's Point, Conn.

Dow Chemical Co.
Midland Div.
Midland, Mich.

Dow Chemical Co.
Riverside Plant
Pevely, Mo.

Dow Chemical Co.
Hanging Rock Plant
Ironton, Ohio

Dow Chemical Co.
Texas Div.
Velasco, Texas

E. I. du Pont de Nemours Co., Inc.
Gibbstown, N. J.

Firestone Tire and Rubber Co.
Akron, Ohio

Firestone Tire and Rubber Co.
Pottstown, Pa.

Foster-Grant Co., Inc.
Leominster, Mass.

General Tire and Rubber Co.
Mogadore, Ohio

B. F. Goodrich Chemical Co.
Louisville, Ky.

Goodyear Tire and Rubber Co.
Akron, Ohio

Koppers Co., Inc.
Kobuta, Pa.

Marbon Chemical Co.
Div. of Borg-Warner Corp.
1926 W. 10th Ave.
Gary, Ind.

Marbon Chemical Co.
Div. of Borg-Warner Corp.
Washington, W. Va.

Monsanto Chemical Co.
Plastics Div.
Addyston, Ohio

Monsanto Chemical Co.
Plastics Div.
Long Beach, Calif.

Manufacturers

Monsanto Chemical Co.
Plastics Div.
Springfield, Mass.

Pennsylvania Industrial
Chemical Co.
State St.
Clairton, Pa.

Permutit Co.
Birmingham, N. J.

Rohm and Haas Co.
Philadelphia, Pa.

Seamco Plastics
Div. Rexall Drug
Holyoke, Mass.

Union Bay State Chemical Co.
Cambridge, Mass.

U. S. Rubber Co.
Nauagtuck Chemical Div.
Baton Rouge, La.

United Cork Cos.
Jamesburg, N. J.

Canada

Dow Chemical of Canada, Ltd.
Sarnia, Ontario

Kayson Rubber and Chemical Co.
Galt, Ontario

Monsanto Canada Ltd.
425 St. Patrick St.
Ville La Salle, Que.

Mexico

Bakelite de Mexico
Monterrey

Foster-Grant Co., Inc.
Monterrey

Monsanto Mexicana S.A.
Lecheria

SOUTH AMERICA

Argentina

Monsanto-Argentina S.A.I.C.
Zarate

Brazil

Bakol S. A. Industria E. Commercio
Sao Paulo, Brazil
(Partially owned by Bakelite Corp.)

Companhia Brasileira de Plasticos
Sao Bernardo
State of Sao Paula
(Partially owned by Koppers and Omni Products Corp.)

EUROPE

Denmark

Dansk Polystrol, Copenhagen
(Associated with Svenska Chemaco)

England

Distrene Ltd.
Barry, South Wales
(Owned jointly by Dow and Distillers Co. Ltd.)

Erinoid Ltd.

Kleestron, Ltd.
Welwyn Garden City
London, S.W. 1

Monsanto Chemicals Ltd.
Corporation Road
Newport, Monmouthshire

France

Huiles, Goudrons et Derives
St. Nazaire, Loire-Inferieure

Pechiney
Ribecourt, Oise

R. V. A.
Lyon, Rhone
(Associated with Huls)

La Societe Monsanto-Boussois S.A.
Wingles P.D.C. 4

Societe Resines et Vernis Artificiels

Germany

Badische Anilin und Soda
Fabrik A.G.
Ludwigshafen/Rhein

Chemische Werke Huls A.G.
Marl, Kreis Recklinghausen

Italy

Mazzucchelli Celluloide
Castiglione Olona (Varese)

Montecatini
Milan

Sicedison S.p.A.
Montova
(Associated with Monsanto)

Spain

Etino-Quimica S.A.
Princesa 52, Pral.
Barcelona
(Partially owned by Monsanto Chem. Co.)

Sweden

Svenska Chemaco A. B.
Stockholm
(Associated with Dansk Polystrol)

ASIA

India

Polychem Limited, Bombay
(Jointly owned by Dow and Kilachand, Devchand Co. Ltd. of India)

Japan

Asahi Dow Chemical Co.
Kawasaki Factory
(Jointly owned by Asahi Chem. Synthesis and Dow Chemical International)

Monsanto-Kasei Chemical Co.
Toho-Cho, Yokkaichi City
Mie Prefecture

AUSTRALIA

C. S. R. Chemicals Pty. Ltd.
9-13 Young Street
Sydney, N.S.W.

Monsanto Chemicals (Aust.) Ltd.
Somerville Road, W. Footscray
Melbourne

materials imports into the United States is very inadequate. Vinyl chloride constitutes the bulk of imports; during 1956 Italy shipped around 25 million lb., Great Britain exported 571,000 lb. to the United States, and Germany sent over 42,000 pounds.

West Germany

Before World War II, Germany was the largest plastics exporter in the world; after the war, the country remained predominantly an importer until 1951. The separation of East and West meant a loss of an integrated economic unit; in West Germany production equipment for condensation and many polymerization products had to be acquired and the supply of many raw materials had to be re-developed through different channels.

After the all-important currency reform of 1948, the industry developed quickly; but exports did not reach significant levels until 1951. Up to that point most of the production was literally "sucked up" by the pent-up domestic post-war demand. In recent years, however, Germany successfully rebuilt her exports on long-established business relations as well as on entirely new contacts. Last year roughly 23% of the entire production was exported—a much larger proportion than in the United States. This intensified "export orientation" of the German plastics industry together with traditional sales aggressiveness made the country again a major competitor in the international plastics market.

So far the German comeback has been mainly limited to Europe and Scandinavia, where British and American exports feel the pinch considerably; Germany sells 80% of her exports in these surrounding countries. Outside of Europe, Germany's success has been confined to Japan, India, and a few dollar-shortage countries in South America. See Table III, p. 103.

Fifty percent of total exports are in the form of vinyls (de-

Vinyl Resin

NORTH AMERICA

United States

Atlantic Tubing and Rubber
Cranston, R. I. (1/1/58)

Bakelite Corp.
Div. of Union Carbide Corp.
Texas City, Texas

Bakelite Corp.
Div. of Union Carbide Corp.
Charleston, W. Va.

The Borden Co., Polyco Dept.
Peabody, Mass.

Cary Chemicals Inc.
Flemington, N. J.

Diamond Alkali Co.
Pasadena, Texas

Dow Chemical Co., Midland Div.
Midland, Mich.

Eleonora Chemical Corp.
Passaic, N. J.
(Subsidiary of The Pantasote Co., Newark, N. J.)

Escambia Chemical Corp.
Pensacola, Fla.

Firestone Tire and Rubber Co.
Pottstown, Pa.

General Tire and Rubber Co.
Ashtabula, Ohio

B. F. Goodrich Chemical Co.
Niagara Falls, N. Y.

B. F. Goodrich Chemical Co.
Avon Lake, Ohio

Goodyear Tire & Rubber Co.
Akron, Ohio

Great American Plastics
Leominster, Mass.

Insular Chemical Corp.
(Owned by Rubber Corp. of America and Roth & Roberts Div. of Pollak Industrial Corp.)
Hicksville, Long Island, N. Y.

Monsanto Chemical Co.
Springfield, Mass.

Polymer Corp.
Los Angeles, Calif.

Presto Plastics
Brooklyn, N. Y.

Thompson Chemical Co.
Hebronville, Mass.

United States Rubber Co.
Naugatuck Chemical Div.
Painesville, Ohio

Canada

Canadian Resins and Chemicals
Shawinigan Falls, Ontario.
(Owned by Union Carbide and Shawinigan Chemicals)

B. F. Goodrich, Canada Ltd.
Kitchener, Ontario

Monsanto Canada Ltd.
Montreal, Que.

Mexico

Geon do Mexico, S.A.
Mexico City
(Associated with B. F. Goodrich)

Monsanto Mexicana S.A.
Lecheria

SOUTH AMERICA

Brazil

Geon do Brasil, S.A.
Sao Paulo
(Associated with B. F. Goodrich)

Manufacturers[1]

EUROPE

Austria

Solvic, A. G.
Hallein, (near Salzburg)

Belgium

Solvic S.A. pour l'Industrie des Matieres Plastiques
Brussels
(Subsidiary of Solvay and Cie, and I.C.I. Ltd.)

England

Bakelite Ltd.
Aycliffe
(Partially owned by Bakelite Corp.)

Bakelite Ltd.
Birmingham
(Partially owned by Bakelite Corp.)

Bakelite Ltd.
Ware
(Partially owned by Bakelite Corp.)

British Geon Ltd.
Barry, Whales
(Associated with B. F. Goodrich)

Imperial Chemical Industries
London

France

Kuhlmann
Brignoux, Isere

Pechiney
St. Auban de Roussillon

Rhone Poulenc
Peage de Roussillon
Isere

Rhone Poulenc
St. Fons, Rhone

St. Gobain
Montlucon, Allier

Solvic
Tavaux, Jura

St. Gobain
St. Fons, Rhone

Germany

Badische Anilin and Soda Fabrik, A. G.
Ludwigshafen/Rhein

Farben Fabriken Bayer
Leverkusen

Farbwerke Hoechst
Frankfurt/Main

Wacker-Chemie
Munich

Italy

A.C.N.A.
Cesare Maderno

Montecatini
Milan

Sicedison, S.p.A.
Porte Marghera
(Associated with Monsanto)

Solvic

Netherlands

N. V. Bataafse Petroleum Maatschappij
Pernis
(Subsidiary of Royal Dutch Shell)

Norway

Norsk Hydro

Spain

Etino-Quimica S.A.
Princesa 52, Pral. Mondoz
Barcelona
(Partially owned by Monsanto)

Solvic

Sweden

Stockholms Superfosfat Fabriks A.B.
Stockholm

Switzerland

Usines Electroniques et Chimiques Lonza, S.A.

Basel

Jugoslavia

Jugovinil
Belgrade

ASIA

Japan

Asahi Dow Co., Ltd.
Nobeoka, Miyazaki Pref.
(Joint ownership, Dow U.S.A.)

Danki Kagaku Kogyo K.K.
Shibukawa, Gunma Pref.

Japanese Geon Co., Ltd.
Kambara, Shizuoka Pref.
(Joint ownership, B. F. Goodrich U.S.A.)

Kanegafuchi Chemical Industry Co. Ltd.
Torikai, Osaka Pref.

Kurashiki Rayon Co., Ltd.
Kurashiki City

Kurashiki Rayon Co., Ltd.
Toyama City

Kureha Chemical Industry Co. Ltd.
Nishiki, Kukushima Pref.

Mitsui Chemical Industry Co. Ltd.
Nagoya City

Monsanto-Kasei Chemical Co.
Yokkaichi City
(Joint ownership, Monsanto U.S.A.)

Nippon Carbide Industries Co. Inc.
Uozu, Toyama-Pref.

Nippon Synthetic Chemical Industry Co. Ltd.
Ogaki, Gifu Pref.

Shin Nippon Chisso Hiryo K. K.
Minomata, Kumamoto-Pref.

Showa Synthetic Chemical Industry Co. Ltd.
Kanose, Niigata-Pref.

Sumitomo Chemical Co., Ltd.
Kikumoto, Niihama City

Tekkosha Co. Ltd.
Sakata, Yamagata-Pref.

Toa Gosei Chemical Industry Co. Ltd.
Nagoya City

Australia

I.C.I. (Australia and New Zealand) Ltd.
380 Collins St.
C. 1
Sydney

[1]The Vinyl Resins class includes polyvinyl chloride and copolymers—50% P.V.C. It excludes polyvinylidene chloride, polyvinyl acetate, polyvinyl alcohol, and polyvinyl ethers.

tailed classification unavailable), 12% are cellulosics, 10% phenolics, 10% polystyrene, and the rest is composed of all other resins with the exception of epoxies. Despite leadership in catalyst polyethylenes, exports of such materials are small. The reason for this probably centers around difficulties in the supply of ethylene which until recently came exclusively from coal. Today the petrochemical industry furnishes increasing quantities of ethylene, but the final balance between the two sources of supply is still undetermined. In this connection it is rather significant that West Germany is the only European country which satisfies 30% of her present crude oil requirements from domestic sources.

West Germany is not only a large exporter, but also imports considerable quantities of plastics each year. In 1956 imports reached 47 million lb. of which the United States supplied roughly 13 million lb., chiefly in the form of polyethylene, special grade polystyrenes, alkyds, and cellophane for the booming packaging industry. Vinyls used for electrical purposes came almost exclusively from the United States due to superior qualities over domestic materials. Other imports came from Switzerland, Great Britain, Netherlands, Italy, and Canada.

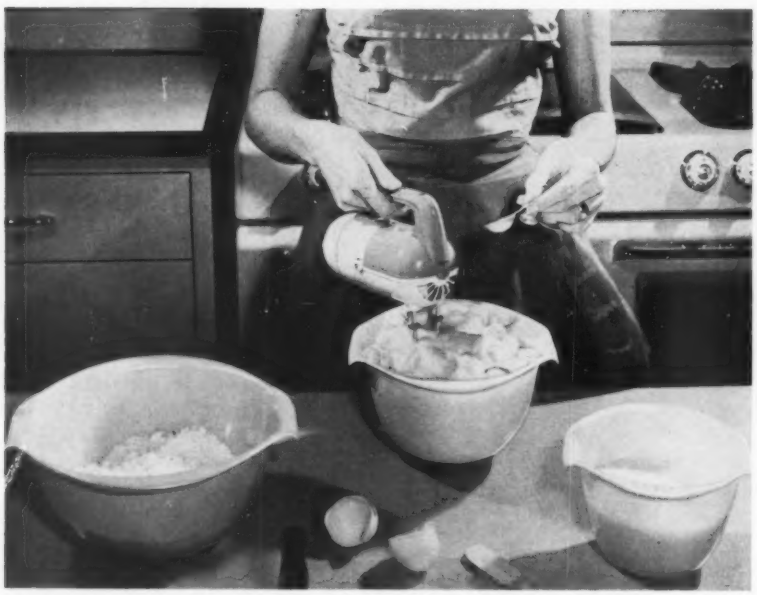
Great Britain

The British plastics industry is even more dependent upon exports than West Germany; approximately 28% of total production is sold abroad each year. It is therefore not surprising that the strong bid for export markets by Germany is particularly felt by Great Britain.

Geographically speaking the country has two large markets for plastics raw materials: the British Commonwealth and Europe. Although exports in absolute figures to Europe are still increasing, a growing proportion of this market has been yielded

(*To page* 230)

Housewares=75,000



First mixing bowls molded of linear (high-density) polyethylene, displayed at Housewares Show, are characterized by unusual stiffness, fine surface, and good color. (Photo, Rubbermaid Housewares of the Wooster Rubber Co.)

Graduated receptacle (arrow) for use with coffee mill is molded of transparent C-11, will not break in dish washer. (Photo, Waring Products Corp.)

Housewares were not especially invented for the benefit of plastics processors, but any visitor to the Housewares Show at Atlantic City could easily believe that the plastics industry's invasion of the field is just about as all-inclusive as Caesar's march through Gaul.

If all the polyethylene, polystyrene, melamine, phenolic (handles), vinyl chloride, and miscellaneous plastics used in housewares in 1956 were placed in a pile, it would weigh at least 150 million lb., or 75,000 tons. The actual poundage would probably be even higher, but there is no accurate scale available for measuring such things as kitchenware, shelf covering, closet accessories, hampers, brushes, appliance and cutlery handles, and the scores of other items in the housewares inventory.

Style-conscious shoppers can decorate polyethylene shopping bags by twining cords, ribbons, flowers, etc., through the open mesh. (Photo, BW Molded Plastics)

Gross volume estimates

A majority of manufacturers and buyers at the show predicted that 1957 gross dollar volume will increase 19% over 1956, but 32% expect only the same volume and 9% expect dol-

tons of plastics+

Most makers and buyers at the July Housewares Show predicted a big increase for 1957, based on better designs and better resins

lar volume to be less in 1957 than in 1956. Twelve percent of 801 buying firms surveyed said that plastics housewares provided their largest dollar volume. This low percentage, of course, is to be expected since cook and bake ware, electrical housewares, clocks, and many other such items which are not reported as plastics housewares are in the higher price brackets. In the same category are bathroom hampers, picnic and baby accessory kits, toilet seats, pans, appliances, brushes, etc., containing plastics parts. In other cases, such as handles for pans and appliances, plastics have driven other materials almost completely out of business.

Wood, once dominant in many housewares, is now used only where it can be sold for its inherent beauty rather than its utilitarian properties; it has given way almost entirely to less costly and more suitable plastics in such items as handles. Metal, of course, is supreme in many areas of housewares, but it, too, gets considerable competition from plastics. In many cases, the two are wedded as in handles, and at least one producer of high-quality metal bathroom hampers and waste baskets has provided a removable polyethylene liner to protect the metal receptacle from corroding. A producer of bowls added another sharp note in this metal-plastics wedding with a bright stainless steel bowl and a tight-fitting polyethylene cover.

Melamine

The improvements in melamine dishware have to be seen to be appreciated; new lines are as different from those of two or three years ago as is a thoroughbred from a plodding old plow horse. Greater translucence, thinner edges, improved balance, colored decoration, and a wide variety of design choice all add to its effectiveness. In some instances, it has the delicate look and feel of fine china. One producer, who started business as a pioneer in

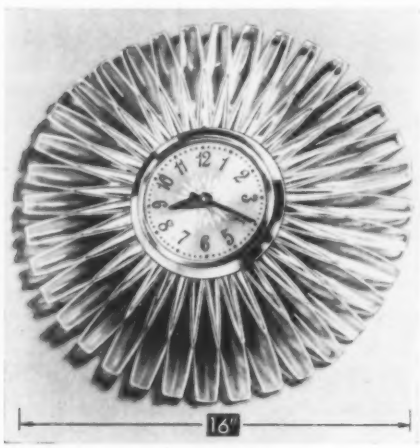
Rectangular polyethylene laundry basket, in bright, attractive color, has solid bottom to keep wet laundry from dripping on floors. Shape facilitates carrying basket through doorways. (Photo, Monsanto Chemical Co.)

Crystal clear styrene tumblers take on a new look with attractive three-color printed decorations. (Photo, Monsanto Chemical Co.)

the early '50's with only one shape and four colors now has several lines, one of which has three shapes with nine decorative patterns in seven color combinations. In addition, 12 solid colors are available.

A significant factor in the melamine tableware situation is that many chinaware manufacturers, who once alternately scoffed and snarled at plastics, are now among the exhibitors. One of them admitted he could exhibit only chinaware at the show because his melamine was all sold out!

Melamine handles for kitchen tools also made quite a showing. Color and resistance to heat make melamine a desirable material for such use. Shrinkage problems have been overcome by development of a unique sliding rivet with which the plastic is fastened to the tool.



Large sunburst wall clock has sparkling rays of molded acrylic. (Photo, General Electric)

Metallic gold and stark white pattern on translucent off-white melamine dinnerware is molded in, is guaranteed for the life of the pieces. (Photo, Branchell Co.)

Acrylic

Methacrylate applications are not often seen in any quantity at a housewares show, but there was one unusual application at this show which deserves special mention. It was a methacrylate housing for a bath scale. Other producers are fancying them up with fur and other soft stuff on the "standing" surface, but in this case the scale has a molded methacrylate housing that adds beauty to good design. It is higher in cost than most scales but is expected to have appeal for discriminating purchasers. Another methacrylate item was a huge sunburst wall clock.

Distinctively new in design was a special receptacle for a new electric coffee mill. It fits under the spout to receive the ground coffee as it pours out of the mill and is graduated to show the amount of coffee that has been ground. It was molded of C-11 which won't break in a dishwasher, is transparent, and is resistant to oils.

Nylon also was visible in unique applications. Two producers showed basters made with molded nylon tubes which are translucent enough to permit sight of the gravy but won't break like glass. Nylon bearings in egg beaters now seem to be almost universal.

Polyethylene

Polyethylene applications, of course, were most prevalent. Volume has stepped up tremendously because of the increase in large items such as buckets, waste baskets, clothes baskets, dishpans, and garbage cans. Even a clothes hamper molded of polyethylene was on display.

A search for low-pressure-processed (linear) polyethylene failed to reveal much of it around. One reason why is that it hasn't been available in large quantity. All molders are conscious of its future possibilities but have varying ideas concerning its progress.

Some molders said they wouldn't use linear polyethylene even if it were available in quantity because they would have to re-educate their customers, who have (*To page* 240)

Report on 4th British Plastics Exhibition

*By Philip Morgan**

The 4th British Plastics Exhibition and Convention[1] was opened to the public in London during July and was attended by approximately 90,000 people, a figure that more than doubles the number at the previous exhibition. Visitors included representatives from 84 different countries and the total foreign attendance was over 6000.

Participating in the exhibition and sharing the 200,000 sq. ft. of exhibition space were 250 firms from 12 different countries which, in addition to the United Kingdom, were: Belgium, Denmark, France, Germany, Holland, Italy, Luxembourg, Portugal, Sweden, Switzerland, and the U.S.A.

Although no absolutely new materials (in the sense of new types of plastics) were shown, a number of developments were exhibited for the first time in Europe at least.

High-density polyethylene

Perhaps the most interesting display was of products made from high-density polyethylenes. This was the first occasion in Europe for a comprehensive display of applications of these materials. Among the products were film, vacuum formed sheet, monofilament, and water pipes hand-fittings.

Commercial production of high density polyethylene by the Ziegler process is now available in the United Kingdom and three grades of melt indexes 2, 0.2 and 0.02 have been announced. In addition to this material products were shown from Continental sources including Ziegler film in gages from 0.0012 upwards, and U.K. sheet in thicker sections was also displayed. Vacuum formings from thin and thick sheet were to be seen. Among the specialized products in high density polyethylene were high density monofilaments, hand-torch bodies and an extensive range of water piping and fittings. Examples of metal products coated with high density polyethylene were also to be seen. Apart from the interest shown in high density polyethylenes, most of the other developments were in fact from other types of thermoplastics.

Vinyl expansion

Vinyls showed little that was new except the now consistently rapid extension of applications. High impact rigid material already familiar in the States, was shown for the first time, and so were a series of monomers and polymers derived from vinyl esters of aliphatic acids.

Developments in polystyrene were mostly in the form of copolymer (*To page* 247)

*Editor, *British Plastics*

[1]For a preview of this exhibition and a list of exhibitors therein, see MODERN PLASTICS 34, 193 (June 1957)

New approaches

Scope of furniture design is widened with use of plastics drawers. Some of the interesting front treatments illustrated at left with injection molded styrene drawers (four sides and bottom) are economically feasible only with plastics drawers. (Photo, Prolon Div., Pro-phy-lac-tic Brush Co.)

Largely experimental until only three years ago, plastics furniture drawers consumed 400,000 lb. of resin in 1955. In 1956 the total was up to 600,000. This year it is expected to climb to 1.5 million lb., divided about evenly between phenolic and styrene alloy. Reinforced plastics also have a foothold in this market and are by no means to be discounted, but the ball is being carried today by phenolic and styrene. Reinforced plastics drawers may get a bigger play sometime in the future; in fact, at least one manufacturer expects to be on the market with such a product within a few months, using improved materials as well as better production methods.

While the predicted 1957 total constitutes an impressive 150% increase over the 1956 figure, it still represents only a small fraction of the potential market. The total number of furniture drawers (case goods, built-in, etc.) produced in the United States is estimated at around 130 million annually. Of this, the styrene drawer people expect to capture at least 10 percent. At an average of 3 lb. per drawer, this represents a potential of about 40 million lb. of resin per year. And the penetration could be even higher, since styrene drawers are thought to be competitive with about 70% of all drawers made. The phenolic people have also set their sights on 10% of the market. With an average weight of 6 lb. per drawer, this comes to a potential annual resin consumption of 70 million pounds.

Economics of drawers

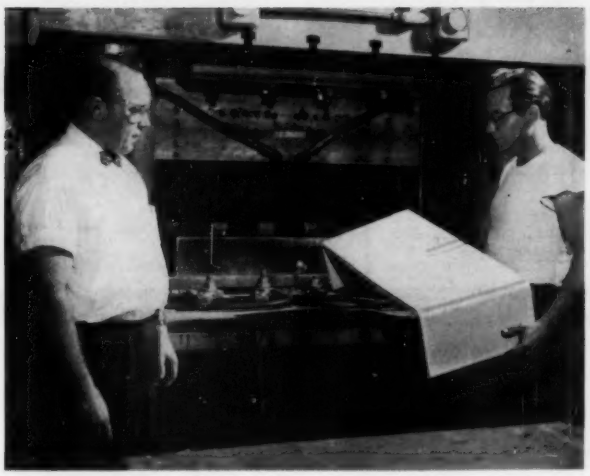
Phenolic drawers, all molded with integral fronts, are highest in cost. They use about twice as much material per drawer as the styrene variety. Tooling cost is also high, with $15,000 per mold an approximate average. Molding is generally done by the single-cavity compression method, which is again an operation that is fairly expensive.

Four-sided (closed-front) injection molded styrene drawers are next in line. While lower in material cost than the phenolic drawer, the

to design, production, and distribution result in a new business:

Plastics drawers

Phenolic drawers, molded by The Richardson Co., in a bedroom dresser. Lustrous black drawer fronts are integrally molded in



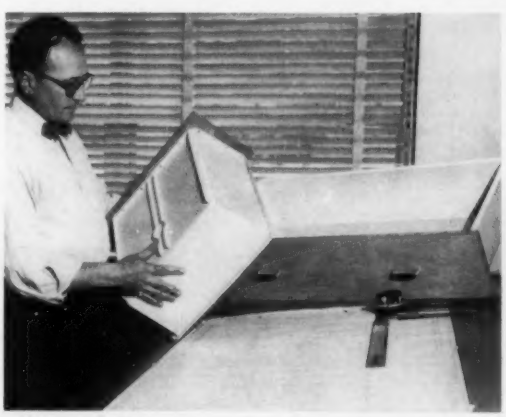
Sears, Roebuck styrene alloy drawer, with open front, is removed from 200-oz. injection machine. Holes along front lip accommodate screws by which separate, generally wooden, front is attached. (Photos, General Electric)

necessary attachment of a separate front adds to over-all cost. Tooling is also high and comparable to a compression mold. Molding cycles are somewhat faster.

Next on the scale are three-sided (open-front) injection molded styrene drawers. Tool cost is slightly less than for four-sided drawers, as is weight of material per drawer. Separate front is an additional cost factor. The seam created at the joint of drawer and front is regarded by some as an objectionable feature of the three-sided drawer.

Last come drawers formed of sheet styrene. The big advantage in this category is low tooling cost, which is about one-eighth that for injection and compression molded drawers. Some of this advantage is lost to the higher cost of impact styrene sheet material. Here, too, attachment of a separate front is an additional cost consideration.

These cost factors, in turn, must be weighed against a range of properties, including chemical resistance, rigidity, toughness, colorability,



Bottom and front views of completed Sears, Roebuck drawers. Molded-in center guide, bottom slides, and rib-reinforced upper flange allow either side and bottom suspension

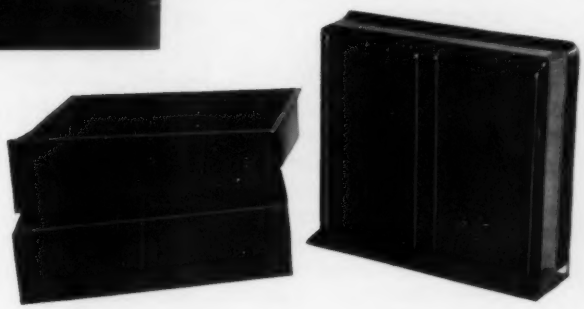
Plastics Drawers: *Molders, sizes, features*

Molder	*Moldowner*	*Size (left to right × front to back × top to bottom), in.*	*Construction and design features*
COMPRESSION MOLDED PHENOLIC			
Admiral Corp., Molded Products Div., Chicago, Ill.	Knoll-Drake Products, Inc. New York, N. Y.	34⅜×18 3/16×7 7/16 34⅜×18 3/16×4 5/16 17⅛×18 3/16×4 5/16	Four sides and bottom molded in one piece; center guide, bottom slides, automatic stops, and drawer divider slots molded in. Suspension channels for side-hanging available. Produced in integral black. Fronts also available in white and grey epoxy coatings. Modular.[a]
The Richardson Co., Melrose Park, Ill.	Proprietary	18×15¾×6	Four sides and bottom molded in one piece. Center guide and bottom slides molded in; drawer divider slots molded in. Produced in integral black.
Boonton Molding Co., Boonton, N. J.	Proprietary	16¾×14½×4¾ 17⅛×14¾×4¾	Four sides and bottom molded in one piece; center guide and bottom slides molded in. Produced in integral black.
FIBROUS GLASS-REINFORCED POLYESTER			
Camfield Fiberglass Plastics, Inc., Zeeland, Mich.	E. H. Sheldon Co., Muskegan, Mich.	13½×19×4½ 9×19×4½ 12×12×4½	Four sides and bottom, matched-metal molded. Produced for slide rail attachment. Brass cardholder attached.
Bangor Plastics, Inc., Bangor, Mich.	Proprietary	13×19×4½	Same as above.
INJECTION MOLDED STYRENE ALLOY			
General Electric Co., Plastics Dept., Decatur, Ill.	Sears, Roebuck Co., Chicago, Ill.	16½×15½×8 34½×15½×8	Three sides and bottom molded in one piece, front open; wooden front to match furniture finish attached to open side with screws through flanges molded into front of drawer. Center guide and reinforced bottom glides molded in. Pastel tan.[b]
	Reiss Mfg. Co., New York, N. Y.	28⅜×16×6⅛	Three sides and bottom molded in one piece, front open. Molded-in tongues along side fronts fit routed out grooves in wooden front and serve as locating guides and means of attachment. Four-way drawer control by means of 3-point suspension system using polyethylene bearings. Molded-in center guides and bottom slides. Pastel tan.[b] Distributed in kit form.
Prolon Plastics, Div., Pro-phy-lac-tic Brush Co., Florence, Mass.	Proprietary	15½×16×5 32×16×5 15½×16×7[c] 32×16×7[c]	Four sides and bottom molded in one piece, separate front necessary. Flange front serves as locating guide and means of attachment of front piece. Molded styrene drawer fronts and molded drawer dividers (snap-in) available. Fronts are attached by screw or adhesive. Molded-in center guide and bottom slides. Modular. Pastel tan.[b]
Amos Molded Plastics, Edinburg, Ind.	Proprietary	22½×15½×4[c] 16½×15½×6[c] 22½×15½×6[c] 34½×15½×6[c]	Four sides and bottom molded in one piece, separate front necessary. Draft on sides for nesting in shipment. Molded-in slots for drawer dividers. Molded-in automatic stops. Molded-in male and female center guides.
FORMED STYRENE ALLOY			
St. Regis Paper Co., Panelyte Div., New York, N. Y.	Curtis Cos. Clinton, Ia. (15¾×19½×5¼); Ferdinand Furniture Co., Ferdinand, Ind. (23×15¼×7, 23×15¼×4¼); Educator Mfg. Co., Tacoma, Wash. (21×19⅜×3); Warsaw Furniture Co., Warsaw, Ind. (12½×14½×3); Hooker Furn. Co., Martinsville, Va. (14¾×16¼×5); Stylemaker Furniture Co., Huntingburg, Ind. (30¾×15¾×6¾, 20¼×15¼×6¾).		Four sides and bottom formed in one piece, separate front necessary. Front flange serves as locating guide and attachment aid for separate front; side guides provided by formed in wooden rails. Pastel yellow.[b]

[a]Modular refers to a drawer design in which the space taken up by two small drawers equals that taken up by one larger one (allowing space between the two smaller drawers); this refers both to vertical and horizontal arrangements.
[b]Colors given for styrene drawers are those in which the items are currently being produced. Because of the ready colorability of styrene, however, drawers can be made in practically any color desired.
[c]Sizes not in production, tools being cut.

Kit for built-in installation consists of open-front styrene drawers (injection molded by G-E for Reiss Mfg. Co.) metal frame, and wooden faces. Center guide rides on metal track incorporated in frame. Molded-in tongues in drawer fronts dovetail with grooves in wooden faces, serve as locating guides and secondary attachment devices

Boonton drawer molded of phenolic, with molded-in center guide and bottom slides. Lip around top permits drawer action by side suspension



moisture absorption, and others, before an intelligent choice can be made of the best drawer for a particular application.

Superior in almost all respects

Advantages of plastics furniture drawers over their wooden cousins are:

1) Molded or formed plastic drawers have no joints to come apart.

2) They are dimensionally stable, will not warp or stick, regardless of atmosphere.

3) Smooth-surfaced throughout, they do not snag clothes and are real life-savers for nylon stockings and fine lingerie.

4) Molded-in colors provide permanent attractive interiors—and often exteriors as well. Refinishing is never necessary.

5) Cleaning is easy—damp-wiping is generally all that is required; there are no corners where dirt can collect.

6) The drawers are sturdy, will almost without exception support the weight of a man standing on the bottom of an inverted unit.

7) Drawer divided slots or drawer dividers can be molded-in.

8) Wooden fronts to match furniture finish are easily attached. Plastics fronts or a combination of plastic and wood are also possible.

9) To the furniture designer they provide an extremely versatile new styling component; to the furniture seller they represent a powerful promotional device with which to infuse new life into stagnating lines.

10) While by no means a cheap substitute for wood, plastics drawers do not appear to be more expensive than their quality wooden equivalents. Accurate figures in this area are

The Knoll-Drake drawer

Epoxy coatings have given this line of drawers a new decorative dimension. The early drawback of these drawers was that they were available only in black. The company is now offering drawers in white and gray fronts, in addition to the black variety. Adhesion of the cured epoxy coating to the drawer front makes chipping virtually impossible. This is not the final word in color range. The versatility of epoxy coatings makes a whole rainbow of colors available, which doubtlessly will be used once the market calls for them. Photo at right shows storage wall consisting of phenolic drawers molded by Admiral Corp. for Knoll-Drake, which illustrates design principle of modular sizes. (See footnote a in table on facing page; photo, Bakelite.)

not obtainable; furniture manufacturers' accounting is not set up to reflect the cost of single drawers.

Market areas

What are the market areas for plastics drawers? The most important is case goods, for which 72 million drawers are produced annually; these include bedroom, dining room, and occasional furniture. Kitchen furniture drawers run at an annual rate of about 10 million; office desk drawers about 2 million. Building construction, home trailers, ships, and do-it-yourselfers all constitute major outlets. Schools are also a fertile field, and that is bound to expand rapidly with the climbing birth rate; other institutional markets, too, loom large, with hotels, hospitals, college dormitories, and a good many similar outlets prime candidates.

Until the beginning of this year, plastics drawers were available in just seven sizes. Only the most progressive designer would consider working with a part having such a limited size range. In a recent study of 24 furniture manufacturers, the number of different drawer sizes made by these firms came to the unbelievable total of 1992.

The recent entry of Panelyte, Prolon, and Amos Molded into the plastic drawer field has alleviated the situation by more than doubling the number of available drawer sizes. Knoll-Drake, now offering three sizes, is expected to market several new ones soon. By 1958, 20 different sizes are anticipated.

An important limiting factor in sizes for plas-

The Prolon drawer

This is the first styrene drawer injection molded with four sides and bottom (closed front), as shown in the photo at left. It is also the first injection molded styrene drawer to be produced on a proprietary basis. Output is about 500 units per mold per day. A molded-in flange serves as locating guide for attachment of decorative fronts. Prolon injection molds a ¼-in.-thick styrene front for this purpose. The company also molds snap-in drawer dividers with molded-in studs.

In photo left, below are shown two-level angular desks which incorporate side-suspended Prolon drawers. Desks were designed by D. Kent Hatch, Jr., of Monsanto's structural plastics engineering group; built by Martin Lumber Co., Springfield, Mass. Working surfaces are decorative melamine laminate manufactured by Pioneer Plastics Corp., Salem, Mass.; side panels (not yet installed on parts of desks) are vinyl film laminated to Masonite. Framing is steel. (Photo, Monsanto Chemical.) Illustrated below, right, is a set of Prolon drawers being installed as part of a built-in storage wall during house construction in Florence, Mass. (Photo, Prolon Div., Pro-phy-lac-tic Brush Co.)

tics drawers has been the cost of tools. It is generally agreed that production of about 200,000 drawers is necessary to amortize the cost of the mold. Given the frenetic competitive situation in the case goods field and the resultant rapidity of style change, furniture manufacturers have been reluctant to invest in custom molds for items whose success depends upon unpredictable market reactions.

Large-volume houses, such as Sears, Roebuck, which sell furniture in great quantities and maintain lines for long periods, are able to take advantage of the benefits of plastics drawers. Smaller ones find it harder. On the other hand, molders, faced with the realities of life in furniture design, have been wary of establishing proprietary lines, and have concentrated on the building and do-it-yourself market.

The successful development by Panelyte of a technique for vacuum forming quality drawers has changed the complexion of the custom molded drawer situation. Instead of going into heavy tooling costs, the case goods maker can order an epoxy mold and make a small run to test customer reaction. Cost of such a mold is about $500. If the piece does not sell, his loss is negligible; if the piece goes over, he can then order a production mold and go ahead. Cost of such a tool (aluminum) is only about $2000, or about ⅛ that of an injection mold.

The proprietary picture has also changed. As long as designers persisted in making drawers the last part of the case to be dimensioned, a proprietary drawer could hardly be marketed economically. Both Prolon and Amos have now reached agreement with several furniture manufacturers to start with given drawer sizes and design the cases around them. As a result, these two companies will be offering four sizes each by the end of the year. Prolon is in production with two now, tooling for two more, and anticipates about ten sizes ultimately.

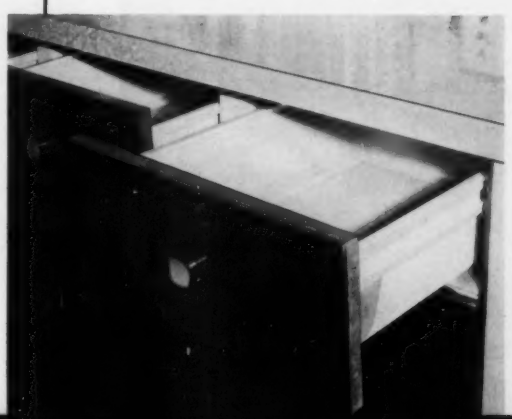
An important factor in bringing about agreement is the fact that furniture designers today are beginning to realize that plastic drawers not only do not necessarily infringe on their creative imagination, but give them completely new design possibilities for exterior as well as interior layouts. For example, it is now conceivable to mold drawers to meet specific functions—for jewelry, for shirts, for lingerie, etc.

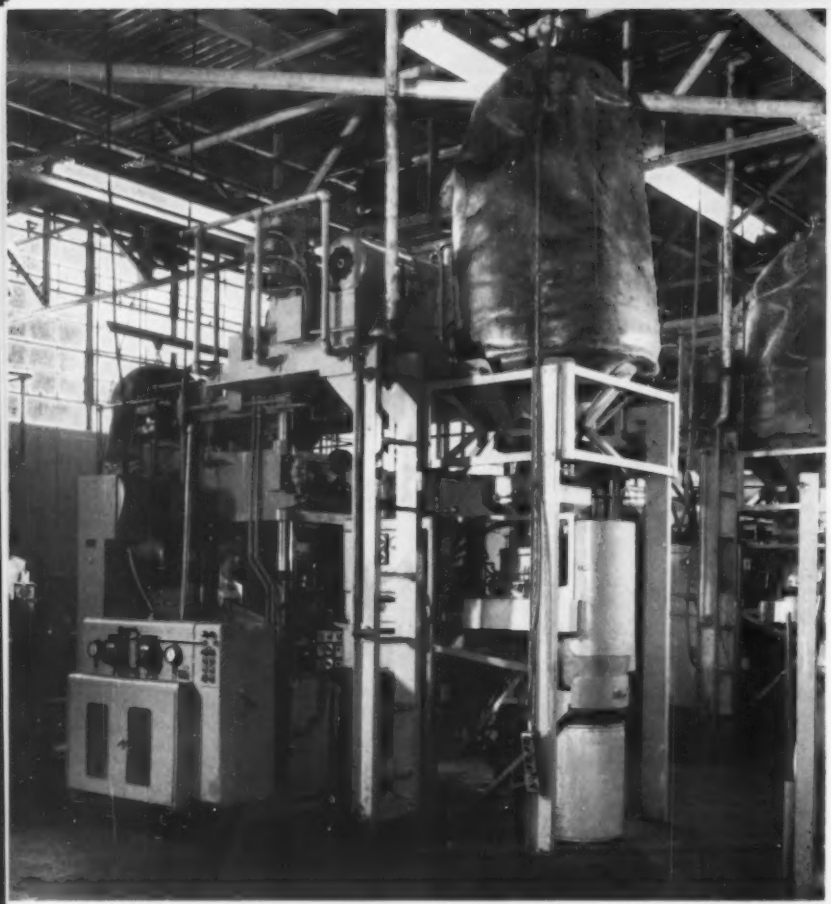
Built-ins . . . and distribution

The building trade and the do-it-yourself markets are naturals for plastic drawers. Housing starts are running at a rate of (*To page* 250)

The Panelyte (St. Regis) drawer

The first successfully thermoformed quality drawers, the Panelyte drawers, are formed of 0.140-in. impact styrene sheet using a female mold with plug assist (see top photo) and a forming technique that is a variation of the air-slip process. The drawers are side-guided with a ½-in. wooden rail insert formed into the sheet along the top of each side. Inserts are loaded at each cycle. In addition to serving as side guides, the inserts also give stiffness and rigidity to the drawer and furnish a member to which wooden fronts can be doweled. Drawer is formed with lip at top edge which fits a groove routed into the wooden drawer front and acts as locating guide and secondary fastening device. Photo at bottom shows vacuum formed drawer as displayed in kitchen cabinets manufactured by The Curtiss Co., Inc., Clinton Div., in a model home. (Photos, St. Regis Paper Co.)





General view of one of the 100-ton automatic compression presses used by Ford Motor Co. in molding of distributor caps, showing relationship of press to mold temperature control unit (left foreground) and flexible rubber drums in which molding material is received in 2300-lb. lots. (Photos not otherwise credited, courtesy Ford Motor Co., Hardware and Accessories Group)

Distributor caps are automatically molded from woodflour-filled phenolic material especially controlled for automotive ignition use. Metal inserts provide connection for spark plug and coil wires

Automatic molding of automotive components

New system of bulk-handling materials, coupled with automatic feeding, preheating of molding powder, and automatic ejection makes for new high in efficiency and economy

By combining automatic compression presses with automatic feeding and high-frequency preheating of phenolic molding powder, without preforming, a remarkably high degree of automation in the molding of automotive components has been attained at Ford Motor Co.'s Ypsilanti, Mich. plant. Included in the installation are seven 100-ton presses used in the production of phenolic distributor caps and four 450-ton presses on which larger-area parts such as water pump impellers are molded.

Part of the efficiency of the Ford installation stems from the bulk-handling of the phenolic molding material. The powder is received from

material suppliers in king-sized rubber bags, each holding 2300 lb. of the material. By means of overhead hoists, these Sealdbins are raised into position above the supply hoppers used with each press. From the hoppers, the material then feeds by gravity into metering devices which apportion the amount of powder required for each mold cavity, ready for high-frequency preheating.

First combination

The Ford distributor cap installation is reported to be the first to combine automatic feeding of molding material, use of preheated molding powder, and automatic ejection of molded parts. Also of interest are the portable mold temperature control units which employ circulating hot oil as the heating medium.

By using the phenolic material in powder form, rather than compacting it into preforms before preheating, space which would otherwise be required for preforming equipment and the storage of preforms is made available for other purposes, including intermediate storage of finished parts. Also, there is no handling of preforms into the preheating unit and from there into the die.

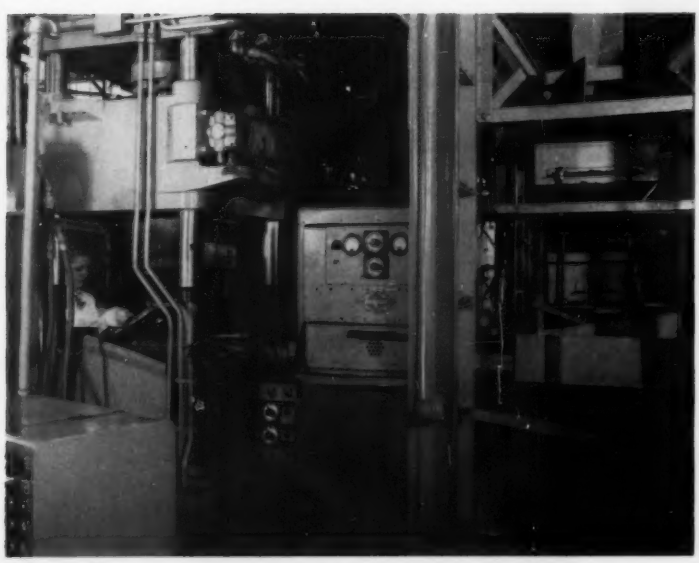
The seven 100-ton fully automatic compression presses used for molding phenolic distributor caps stand approximately 16 ft. high. Ladders provide quick access to the overhead motor pump and valves. This overhead arrangement permits maximum floor space on all four sides of the presses for the preheater and automatic ejection parts. These presses have a 64- by 60-in. over-all platen area, a 24-in. stroke, and maximum daylight of 45 inches.

The 6½-oz. distributor caps are produced in four-cavity molds. Because of exacting electrical requirements, the molding material used is a general-purpose, two-stage, woodflour-filled phenolic especially formulated for automotive ignition use.

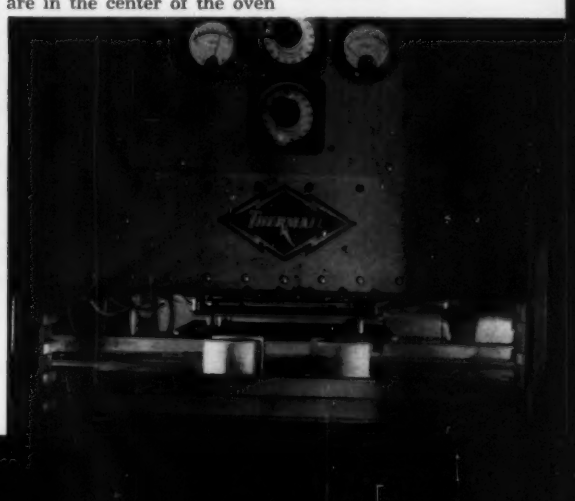
Behind each press is a metal framework having a conical cradle at the top. The supply bags of molding material, elevated by electric hoists, are lowered into these cradles. A screw fitting on the bottom of the bag is then removed and a nylon "sock" withdrawn, permitting the phenolic material to flow by gravity into the supply hopper below. When a bag is empty, it is quickly replaced by a filled container, completely collapsed, and returned to the supplier.

Volumetric dispensing

From the supply hopper, the molding material passes through a volumetric dispensing device which meters it into four heavy-walled tubes or cups made of Teflon. These cups carry the material through the preheating cycle and thence to the molding dies. Release of the powder from the supply hopper is controlled by a



Closeup of one of the presses shows material feed hopper (right) with metering hopper below it which feeds material into Teflon cups that carry the plastic through high-frequency preheater (center). Part of oil circulating type mold temperature control unit is at lower left. Operator at left is preparing to deposit inserts in mold with loading fixture



Closeup of high-frequency unit in which phenolic material is preheated in powder form prior to molding. The four Teflon cups, which move on a wheeled platform, are in the center of the oven

Press operator placing metal inserts in insert loading fixture while curing cycle is in progress. Hinged shrink fixtures are in background and foreground

limit switch and timer integrated with the operation of the press. Actual dropping of the phenolic material into the Teflon cups is regulated by two sliding metal plates having openings through which the powder passes. The plates are actuated by air cylinders.

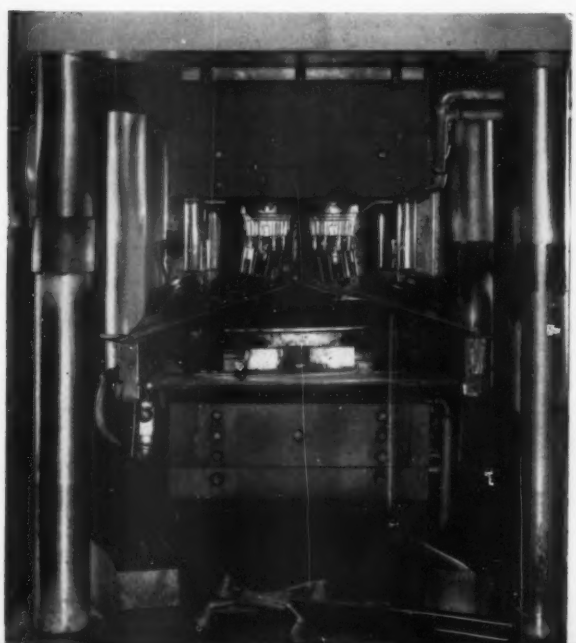
Teflon is used for the preheating cups because the dielectric properties of this material prevent it from being heated when exposed to the high-frequency field. Also, the high heat resistance of the material prevents it from being damaged by the heated phenolic powder. The Teflon cups are supported on a wheeled platform which rides on metal tracks extending from the loading hopper through the preheater to the press platens. The loading cup carrier is actuated by a chain drive.

The high-frequency preheater, mounted directly behind the press, is constructed with open ends, permitting the powder loading tray to move into the oven and then on into the press at the end of the preheating cycle. A hinged door at the bottom of the unit permits a direct view into the interior of the electronic oven.

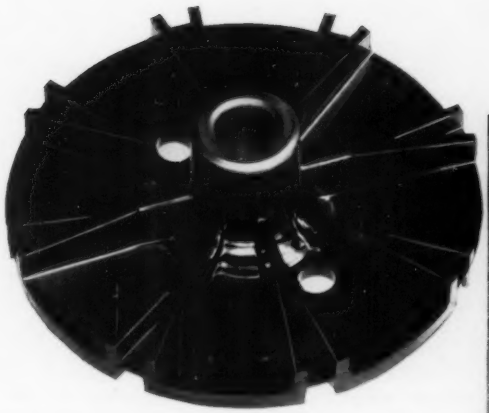
Close control necessary

The preheating operation must be closely controlled so that the material reaches the maximum permissible temperature without curing before it is transferred into the mold cavities. The trick consists in getting the material up to a safe maximum preheat without, however, causing it to "kick over" and begin setting-up in the Teflon cups.

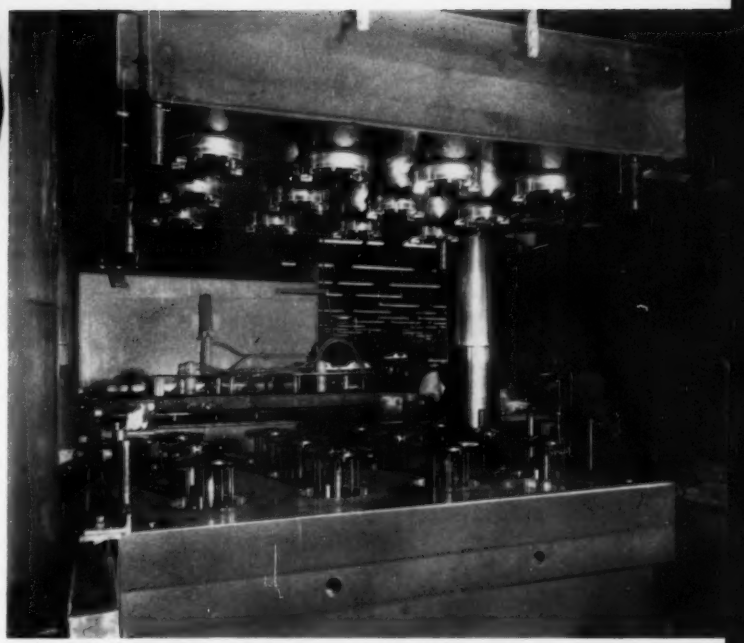
Operator has just transferred inserts into the four die cavities from loading fixture. Molded parts from previous cycle are on upraised punch half of mold



When safety buttons are pressed, molded parts are ejected from cores, falling on sloping sheet metal shield and tumbling down chutes at both sides of mold. Simultaneously, Teflon cups move into position over the mold, dump preheated powder into cavities, and retract



Closeup of water pump impeller part molded in 12-cavity die on 450-ton automatic compression press. This phenolic part has sintered iron shaft bushing as insert in center. (Photo, Baker Bros., Inc.)



Closeup of 12-cavity mold in which water pump impellers are molded shows plastic parts supported on ejector pins, ready to be automatically removed from the die

Also vital to this automatic molding operation is close control of mold temperatures. In the temperature control units, the heat is supplied by two immersion units of 12 kw. each. The heat transfer oil, contained in a 9-gal. supply tank, is circulated through both halves of the mold by positive-displacement pumps having a capacity of approximately 10 gal. per minute. Relief valves limit pressure to 25 p.s.i. Piping is so arranged that the two halves of the temperature control unit can be operated separately or in combination. In molding the distributor caps, the top (punch) half of the die is run somewhat hotter than the cavity. This guards against precure and inadequate flow of the molding material around the metal inserts, which are placed in the lower half of the mold.

Each press requires one operator. His duties consist of loading the distributor cap inserts into fixtures during the curing cycle, transferring the inserts into the mold cavities between molding cycles, performing a limited deflashing operation, and placing the distributor caps in hinged shrink fixtures which exert pressure on the top of the parts and prevent warping while cooling.

The insert loading fixtures hold 28 inserts for the 6-cylinder engine distributor caps and 36 inserts for the 8-cylinder components. Each loading fixture drops inserts into all four cavities simultaneously when the release lever is tripped. Originally, all inserts were of brass, but a gradual change-over is being made to aluminum inserts, which may be produced more economically by impact extrusion.

Through an ingenious arrangement on the molding presses, preheated phenolic powder is released into the mold cavities at the same instant that finished parts from the previous cycle are being pushed off the hydraulically-operated ejector pins. When the press opens automatically at the end of each cycle, the distributor caps are retained on the cores of the upper half of the mold. At this point, the operator places the insert loading fixture on the lower half of the mold and trips a lever, which transfers the inserts into the cavities. Placing the insert loader aside, the operator then presses two safety switches which initiate the next cycle.

Two operations then take place simultaneously. The loading cups move (*To page* 252)

Lightweight slab of polystyrene foam is easily handled by workman during installation of plastic insulation in food warehouse. Slabs were molded of Koppers expandable polystyrene by Dyfoam Corp. (Photo, Koppers Co., Inc.)

Markets in the making for

Unlike the flexible plastics foams covered in last month's MODERN PLASTICS (p. 115), the much larger family of rigid foams, with the single exception of foamed polystyrene, is not yet on the eve of any major market breakthrough.

However, the long-range potential of rigid foams, taken as a whole, is even greater than that of flexible foams—because of the number of materials involved and the almost infinite number of ways they can be formulated for different end results.

The list of rigid plastics foams includes ten basic materials: polystyrene, urethane, vinyl, cellulose acetate, epoxy, phenolic, polyethylene, silicone, urea, and—a new entry—polyester foam. Most of these are destined to play increasingly important roles in all phases of industry.

In the case of two of these materials, urethane and vinyl, there is no hard and fast line between the rigid and flexible varieties of each. They can be formulated over a wide range, from very hard to very soft. The other foams are all rigid, except for polyethylene, which can be classified either way. Like the resin from which it is derived, cellular polyethylene is certainly not rigid; however, it is not compressible in the sense that a cushioning material is compressible. It is therefore grouped here with the rigid foams.

The rigid foamed plastics are marked by the sweeping industrial possibilities they offer and the almost equally great problems they pose. These problems center around the lack of technical know-how on the part of the foam manufacturers and the lack of education among end-users. Progress has not been uniform, but most of the technical problems promise to yield before sustained research effort. Education of the customer is a matter of time and promotion efforts. Actually, in the case of urethane foam, the main factor impeding progress is the very existence of its flexible cousin. Most of the research and development time, money, and talent of urethane producers is going into flexible foam, which has markets with more immediate sales potential and are considerably easier to reach.

Polystyrene foam

None of the foregoing is true of foamed polystyrene. This material has already reached substantial volume and is undergoing a big sales spurt this year. According to a current estimate by Paul G. Roach, chairman of the Cellular Plastics Div. of S.P.I., production of all types of rigid styrene foam reached 8 million in 1956, and will hit 12 million lb. this year, a flat 50% increase. Dow Chemical Co., Midland, Mich., main producer of prefoamed polystyrene, says its Styrofoam on a board-foot basis is now outselling cork—a leading and long established insulation and flotation material.

Two new Styrofoam plants were brought on stream in 1957 at Hanging Rock, Ohio, and Riverside, Mo. These new facilities double Dow's capacity for the foam. The company is now designing more plants and continuing to expand its already sizeable distribution facilities.

Styrofoam is sold, like lumber, in boards or planks which are nailed, cemented, or simply laid in place. The big market for the material is low-temperature insulation in construction and transportation. In increasing amounts, Styrofoam is going into residential, institutional, and industrial building—in foundations, floors, walls, and roofs. The material is also being employed as insulation in refrigerated railroad cars, dry ice containers and trucks, and on fishing boats. These are all large-scale markets for which Styrofoam offers interesting and sometimes unique possibilities.

What Dow terms "medium sized" markets for Styrofoam are the buoyancy, novelty, display, and floral fields. Smaller outlets, at pres-

RIGID FOAMS

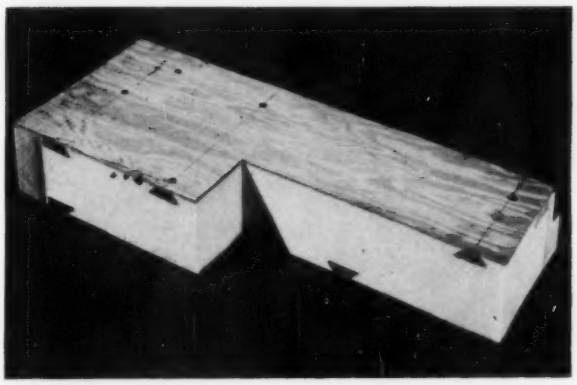
Ten materials and a broad range of formulations offer a selection of properties and prices

ent, are the packaging and electronic industries.

The advantages of pre-foamed styrene that account for its present position and assure its future are low cost, compared to most other foams, extreme light weight, and excellent water resistance and dielectric characteristics.

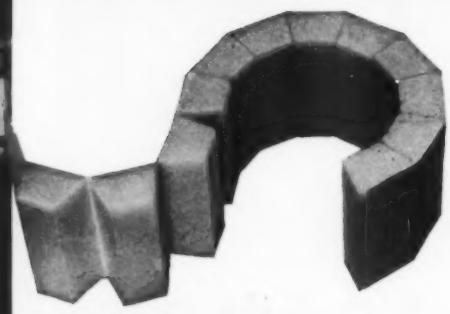
Foamed in place

But the type of plastic foam which has stirred the most interest involves the materials that can be foamed in place. Probably the leading example of this nature on the market is the foamable styrene offered by Koppers Co., Pittsburgh, Pa., under the tradename Dylite. This product is in the form of expandable beads which the buyer fabricates into various foamed shapes by molding or extrusion. Koppers reports excellent sales of Dylite beads; the company sold every pound it could make at its semi-commercial plant and is bringing into production a big new plant with capacity of



Section of large (85- by 58- by 4-in.) sandwich panel with urethane foam core of 1.8-lb./sq. ft. density in ⅛-in. plywood skins. Picture shows complete absence of voids; bond between plywood and urethane is stronger than foam itself. (Photo, Allied Chemical)

Ducts and pipes of complex air-handling and refrigeration system use foamed styrene insulation. (Foam is covered with canvas to protect it from physical damage.) This installation, which controls the air in a series of blood sera rooms maintained by a pharmaceutical firm, required a full carload of foamed styrene. (Photos, Dow)



Refrigeration lines operating at temperatures as low as —30° F. are insulated with low-cost, easily installed pipe covering consisting of foamed styrene with vinyl skin. Covering is supplied by Baughman Insulators, Inc. (Photo, Dow)

Sphere molded of expandable styrene foam (background) and half of mold used to make it. The sphere, developed at Naval Research Laboratory for use as a float, weighs only 42 lb., yet can support loads up to 800 lb. in water. (Photo, Koppers Co., Inc.)

10 million lb. of expandable beads a year. The plant, at Kobuta, Pa., should be in operation by the first of the year. The markets for expandable styrene are similar to those for prefoamed; the main advantage is lower shipping cost, since a great deal more material can be put into the same space.

Dow Chemical is also readying an expandable bead styrene for the commercial market; developmental quantities are already available. Before full-scale introduction, Dow reports it is trying to solve the problem of uniform expansion under conditions where laboratory control cannot be maintained.

An idea of foamed styrene's market penetration can be gained from the fact that three of the leading cork insulation firms in the U.S.,—United Cork Co., Kearny, N.J., Armstrong Cork Co., Lancaster, Pa., and Mundet Cork Corp., N. Bergen, N.J.—are all now producing foamed styrene for construction and pipe insulation. Another firm in this field, Dyfoam Corp., New Castle, Pa., was set up especially to produce foamed styrene insulation. Dyfoam offers continuous slabs of foam, and has sold lengths up to 17 ft. commercially.

The other plastics which can be foamed in place besides styrene are urethane, phenolic and the related syntactic foams, and silicone.

Prefoamable materials, besides styrene, are cellulose acetate, epoxy, urea, polyethylene, and polyester.

Urethane

Rigid urethane foam, which can be manufactured with a wider range of properties than any other foamed plastic, is as yet a poor sec-

Liquid urethane (circle) is poured into plywood form, using meter that dispenses measured charge automatically. Material foams in place without heat to produce structural panel. (Photo, Nopco)

ond to polystyrene foam in terms of sales, but second to none in terms of long-range posibilities and general interest. Conservative estimates for rigid urethane production this year range from half a million to one million pounds.

Describing the prospects of rigid urethane, a spokesman for Mobay Chemical Co., St. Louis, Mo., raw materials supplier, says: "the quantities are fabulous, the stakes are high, the costs are high, and the risks are high." Fabulous is a word that's sure to be used wherever urethane men congregate. In general, the noteworthy qualities of rigid urethane are high strength/weight ratios, insulation value, excellent bonding characteristics, and good thermal resistance.

Foamed in place (the main way rigid urethane has been used), the foam exhibits exceptional adhesion to a wide variety of materials.

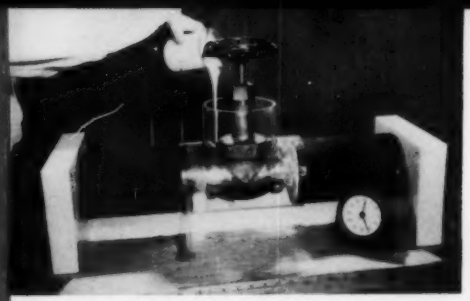
Rigid urethane is a reaction product of isocyanate and polyester. There are many sources of supply for the polyester but up to date there have been only three major producers of isocyanate for foam: Mobay, Du Pont, and Allied Chemical & Dye. Another company has just entered the competition: the Carwin Co., North Haven, Conn. Carwin calls the product polymethyl polyphenylisocyanate. The chemical is now emerging from the development stage and is ready to go on the market. Rigid urethane made with this product will have much higher heat resistance than other types now available. According to Carwin, the new foam will withstand temperatures up to 600° F. and up to 400° with only 2% shrinkage.

A number of impressive applications have been made of urethane as structural insulation such as in Monsanto's House of the Future, where 7-lb. density material 4 in. thick was used in walls and floors. But each of these jobs had to be specially engineered. Urethane cannot expect to penetrate the large-scale insulation markets as a foamed-in-place material until processing methods are greatly simplified.

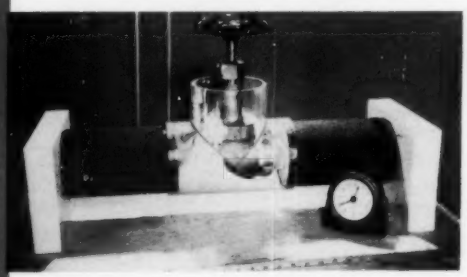
Considerable strides in this direction are reported by National Aniline Div. of Allied. With a new rigid foam formulation employing Nacconate 1080-H as the isocyanate ingredient, Allied has achieved ease of application with simple equipment (just a mixing machine and a bucket) with predictable results. In a series of five tests, the company made five large foamed-in-place plywood faced sandwiches having a variation in foam density of only 0.1 lb. in 20 lb. batches. (See picture, p. 125).

Many urethane experts foresee the day when a mobile mixing truck will be used by builders to pour urethane foam insulation on the job site. Before this cement-mixer type of operation can be achieved, however, more technical knowledge has to be gained by the foam manufacturer, and the contractor has to be educated.

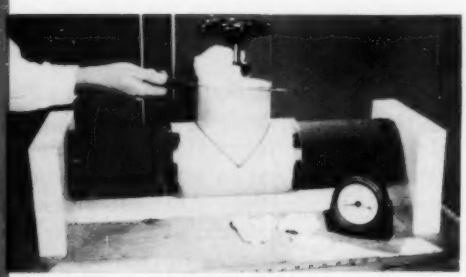
According to John J. Reed, Allied's isocyanates sales manager, the principal mechanical problem that remains to be licked is a method



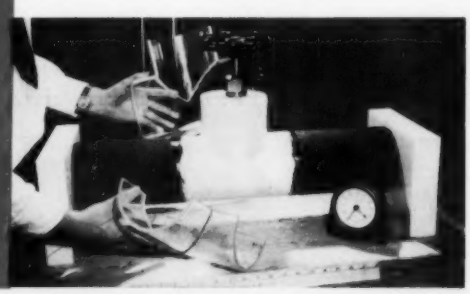
Ingredients for foamed-in-place urethane are poured around valve to be protected . . .



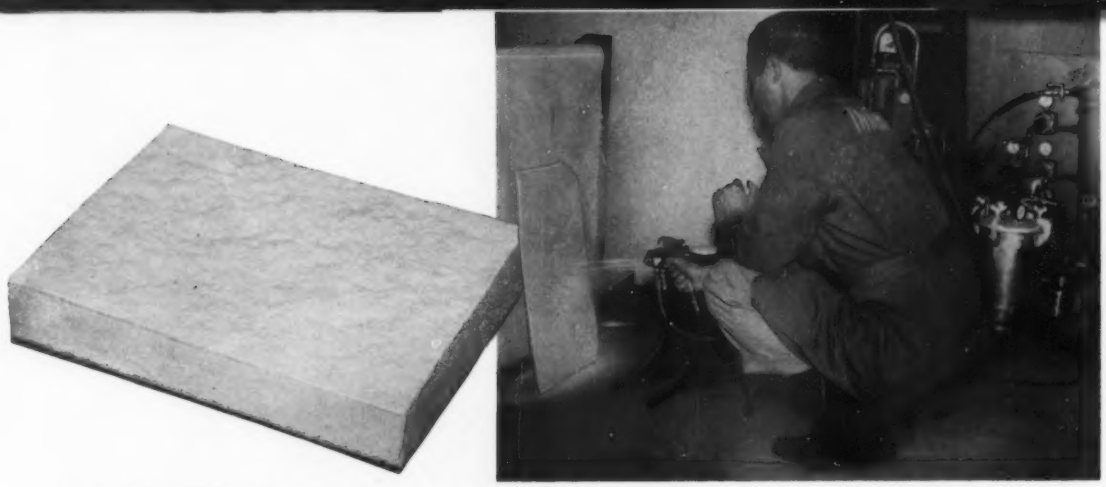
Foaming starts instantly . . .



And is completed in less than 10 minutes. Excess foam is now removed and . . .



Mold is taken off. Total time for insulating job: 22 min., 35 seconds. (Photos, Du Pont)



Foaming urethane in place by use of a spray gun. Workman (right) sprays ingredients (which are mixed at nozzle) on metal panel, using DeVilbiss catalyst equipment and a new formulation of urethane manufactured by American Latex Corp. Foaming begins as soon as liquid hits panel and continues until a fully expanded depth of 2 in. is reached. Finished panel is at left. (Photos, American Latex)

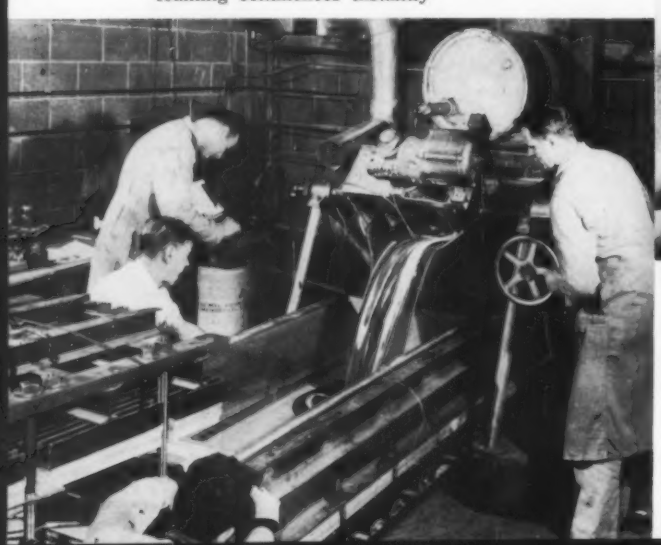
of holding building panels in some kind of jig during foaming to keep the internal pressure generated in the reaction from bursting the skins.

Considerable market advances in rigid urethane are being made by Nopco Chemical Co., Harrison, N.J. Nopco leases machinery and sells resin systems to end-users who do their own foaming-in-place. About 15 firms, each of which uses a minimum of 10,000 lb. of material a year, are leasing machines from Nopco. Most of them supply pre-fabricated panels to the building trade, which consist of a urethane foam core and thin skins of steel, aluminum, or wood.

The big advantage of urethane over styrene for insulation are heat resistance (250° F. against about 175° F. for styrene), and much superior structural strength and vibration resistance. The disadvantage of urethane, compared to foamed styrene, is the price. Urethane coring material costs roughly $1.50/lb. compared to about 75¢ for Styrofoam.

There is one factor that could change this price differential drastically, and tip the scales in favor of urethane: a switch from polyester to polyether for reaction with isocyanate in the manufacture of urethane foam. The new polyether material, at roughly half the cost of polyester, has pushed the latter out of the running in flexible urethane. So far, all rigid urethane foam has been made with polyester. But Dr. Phelps Trix, director of market research for Wyandotte Chemical Co., Detroit, Mich. (a basic supplier of polyether and a pioneer in the field), feels that polyether will (*To page* 262)

Liquid epoxy resin, mixed with chemical blowing and curing agents, is poured from mixing barrel into trough, where foaming commences instantly



Pocket knife slices cleanly through block of epoxy foam. Because of its uniformity and freedom from grain, the foam can be easily carved and is readily machinable. (Photos, DeBell & Richardson)

American delegation to ISO/TC 61 meeting held in Switzerland, July 8-13. Left to right: N. A. Skow, G. M. Kline, R. K. Witt, Robert Burns, C. Howard Adams, E. Y. Wolford, J. E. Willard, A. C. Webber

INTERNATIONAL PLASTICS MEETINGS

ISO/TC 61 on plastics

The 1957 meeting of Technical Committee 61 on Plastics of the International Standardization Organization was held at the Burgenstock, Switzerland, on July 8-13. Sixteen countries were represented by 101 delegates and observers, as follows: Belgium (2), Czechoslovakia (4), France (14), Germany (9), Hungary (1), India (2), Italy (12), Netherlands (6), Poland (4), Roumania (2), Sweden (8), Switzerland (16), Union of South Africa (1), United Kingdom (9), United States (8), U.S.S.R. (3).

The American Standards Association, which is secretariat for ISO/TC 61, was represented by C. Howard Adams, leader of the U. S. delegation (Monsanto Chemical Co.); Robert Burns (Materials Advisory Board, National Academy of Sciences); G. M. Kline (National Bureau of Standards); N. A. Skow, representing the Society of Plastics Engineers (Synthane Corp.); A. C. Webber (E. I. du Pont de Nemours and Co.); P. E. Willard (Ohio-Apex Div., Food Machinery and Chemical Corp.); R. K. Witt (Johns Hopkins University); and E. Y. Wolford (Koppers Co., Inc.).

Dr. Kline was chairman of the meeting, Dr. W. Fisch (Ciba Co., Switzerland) was co-chairman, and N. A. Skow and H. Maurer (Switzerland) were technical secretaries.

The committee approved six new Draft ISO Recommendations and six Draft ISO Proposals at the Burgenstock meeting. Eighteen Draft ISO Recommendations covering methods of test and equivalent terms have previously been adopted. The new Draft ISO Recommendations describe methods of test for Charpy and Izod impact strength, incandescence resistance, thermal stability of polyvinyl chloride compounds by Congo Red and discoloration methods, and bleeding of colorants from plastics. The Draft ISO Proposals relate to the determination of tensile properties of plastics and melt flow index of polyethylene, (*To page* 271)

Polyethylene drum

A single-trip, non-returnable polyethylene drum has been developed for use as a liner inside fibre or steel drums. Fabricated by the blow-molding process, the liner is a one-piece, seamless shipping container, complete with an integral cover. The polyethylene is unaffected by muriatic, formic, and hydrofluoric acids, hydrogen peroxide, and many other corrosive materials.

With its outer shell, the 30 mil polyethylene container may be handled, palletized, filled, emptied and shipped exactly like a steel drum. The user reaps the benefits of great weight saving and ease of handling. Designed to carry 800 lb. gross weight, the liner has an outer diameter of 22½ in. and a height of 33 in. Two openings, ¾ and 2 in. diameter, to which any desired filling and emptying closures may be easily fitted, are molded into the cover.

Credits: Developed and manufactured by Delaware Barrel and Drum Co., Wilmington, Del.

PLASTICS

Vacuum-formed decorative materials

Handsome textured surfaces can be had anywhere with new, lightweight decorative materials now being vacuum-formed of rigid PVC sheet. Patterns available in Decor-vac are mosaic tile, draped curtain, wood siding, shell, log, shingle, and various brick and stone textures. The unplasticized formed vinyl, supplied in 2 by 4 ft. sheets, is easy to cut to shape; sheets are mounted on straight or curved surfaces by means of an adhesive. The textured sheets are durable and can be washed without damage when soiled.

At a tenth the cost of imported tiles, the mosaic tile (shown in the center of the photo) gives the handmade appearance and fired glaze luster of real mosaic. The pattern and colorings of the tile are silk-screened onto the vinyl sheet before vacuum-forming to produce the tile pattern.

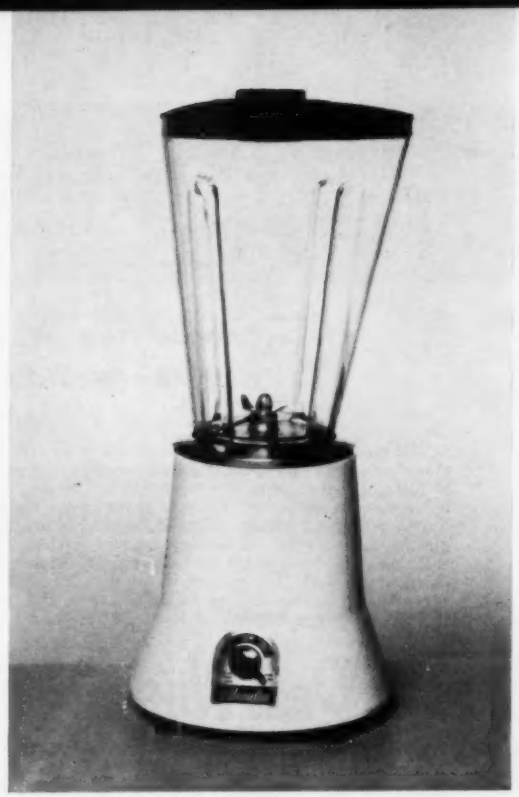
Credits: Made by W. L. Stensgaard and Associates, Inc., Chicago, Ill., of Seilon rigid PVC from Seiberling Rubber Co. Plastics Div., Newcomerstown, Ohio.

Household blender

One of the main features of a new household food blender is its clear plastic bowl which is shatter-resistant and transparent. The bowl of the Blendal, as the new mixer is called, has these virtues because it is injection molded of styrene-acrylonitrile copolymer material. Shatter-resistance is particularly important in such household products that are frequently moved from place to place and are usually cleaned after each use, with resultant possibilities of impact.

The same styrene material is used in the leak-proof bowl cover provided with the Blendal. Both bowl and cover are easy to clean, safe to use, and light in weight for convenient handling. Designed to cut faster and finer with less foaming and heating of ingredients, the new blender has both speed fins and a flat-bottom container.

Credits: Manufactured by Dewenter Industries, South Pasadena, Calif., of Styrex copolymer material from Dow Chemical Co., Midland, Mich.



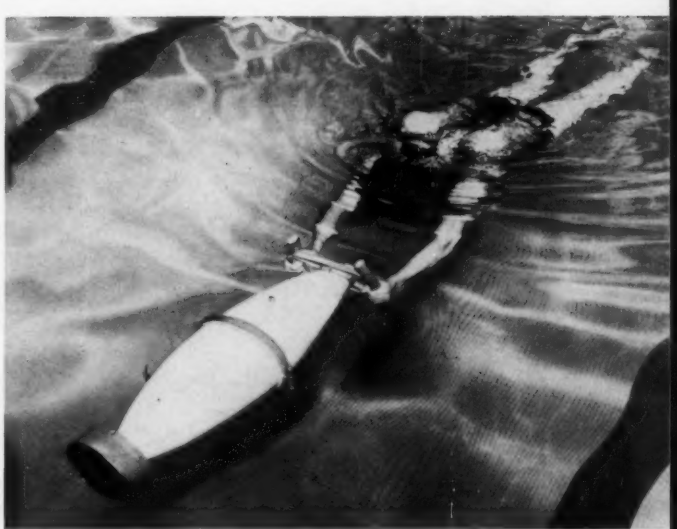
PRODUCTS

Power for a skin diver

Underwater sports enthusiasts can enjoy hour-long excursions at depths as great as 100 feet below the surface with the Power Diver, a new cigar-shaped propulsion unit. The device is powered by either a 6- or 12-v. rechargeable battery encased in a strong shell, $\frac{3}{16}$-in. thick, of reinforced polyester resin. Weighing only 1½ lb. submerged, the reinforced plastics body shell has ample strength to withstand the most severe pressures.

A strong and permanent bond is achieved between the case of the Power Diver and its anodized aluminum steering handles, controls, and propeller guards by cementing with a polyester resin. According to the manufacturer, the bond will withstand any of the considerable stresses that are likely to be put on the device by a 200 lb. diver moving at 2 m.p.h. underwater.

Credits: Manufactured by Link Aeronautical Corp., Endicott, N.Y. Polylite polyester resin supplied by Reichhold Chemicals, Inc., White Plains, N. Y.



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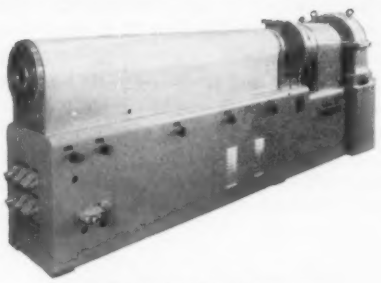

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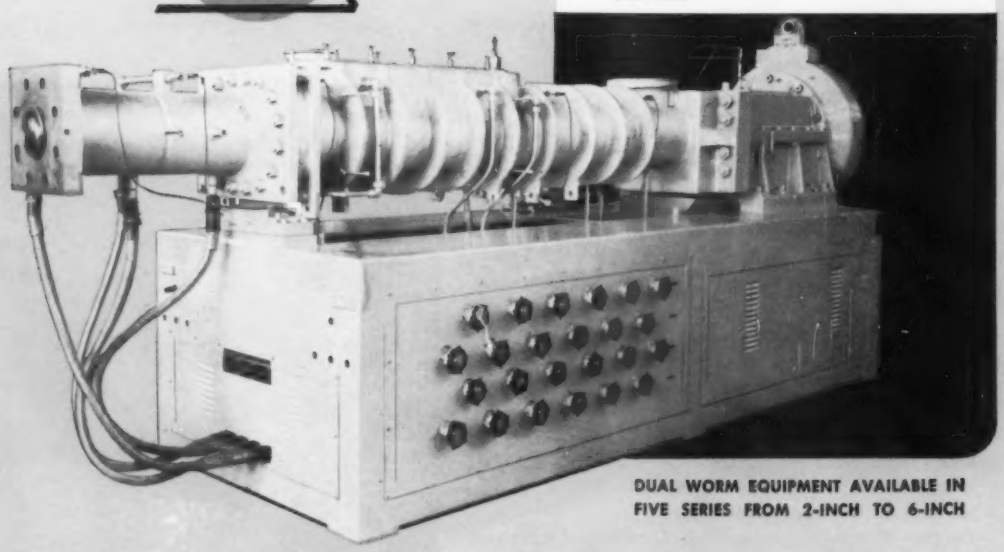

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Design and fabrication with

Directionally reinforced plastics—I

By A. L. Donaldson and R. B. Velleu†

Directionally reinforced molding materials make it possible to develop, even in complex structures, a pattern of strength corresponding closely to the expected pattern of stress in service. Thus the designer need not pay a weight penalty for unwanted strength in random directions, as with isotropic materials of construction. Tensile strengths up to 120,000 p.s.i. are possible at tensile moduli up to 5.9 million p.s.i., and lot-to-lot uniformity of properties is excellent. Because these reinforced epoxies are not sensitive to environmental conditions, abrasion, notch effects, etc., the strengths realized in service approach the laboratory values. Typical design applications are discussed in Part I of this article. These materials are easily molded at low pressures into a range of shapes requiring up to 20% draw and they are heat cured by standard techniques. The hardest abrasives and tool bits are recommended for grinding and machining the laminates.

Molding, machining, and finishing procedures will be given in Part II of this article, to appear next month.

Reinforced plastic materials now are available in which the orientation of the reinforcing filaments can be controlled to meet specific stress conditions. This means that the designer can specify strength in one or more directions, based on anticipated loadings, without paying the material weight penalty required when strength is uniformly distributed. A part can be made as much as 40 times as strong in one direction as in another. Laboratory test data are available on these materials and correlation of field experience with test data is rapidly being made.

These reinforced plastics are supplied in forms such as tapes and sheets which facilitate prototype and pilot-plant production with temporary tooling. The results of such trial production are reliability indicative, performance-wise, of what may be expected from full-scale production because of the built-in uniformity of the material.

The principle

Perhaps the earliest attempts to reinforce plastics were the addition of various materials in particle form. While these small-particle reinforcing agents did increase some of the physical properties of moldable plastics, their ultimate performance left much to be desired. In an effort to attain higher strengths, plastics pioneers employed filaments oriented in a woven pattern such as cloth, or non-oriented fibers as in mat, as the reinforcing medium. Interference between filaments of different orientation or lack of orientation prevented the realization of full strength potential of filament reinforcement. However, the woven and mat reinforcements were convenient for molding, and until recently, fishing rods and the like were the only products in which it was practical to take advantage of the much higher

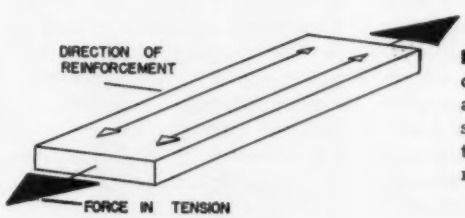


Fig. 1: Schematic diagram of section of unidirectionally reinforced plastics sheet stressed in simple tension in the direction of reinforcement

* Reg. U. S. Pat. Off.

† Technical service manager and applications engineering group supervisor, respectively, Reinforced Plastics Div., Minnesota Mining and Manufacturing Co, St. Paul, Minn.

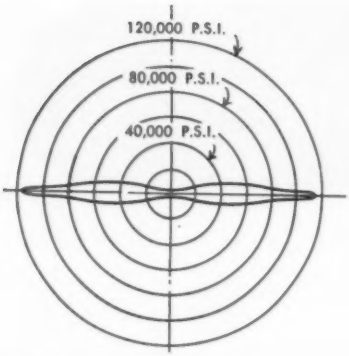


Fig. 2: Tensile strength of unidirectionally reinforced epoxy as a function of the angle between the direction of reinforcement and the direction of applied stress. Reinforcement runs along horizontal axis. Length of radius vector to curve at any point is proportional to strength in that direction

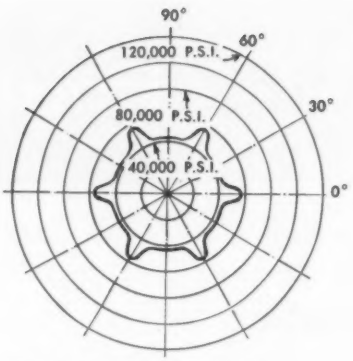


Fig. 4: Isotropic material, with reinforcement equally distributed in an asterisk pattern, has almost the same tensile strength in all directions in the plane of the material. Gain in uniformity is made at sacrifice of extreme strength in preferred directions, a characteristic achieved with other patterns

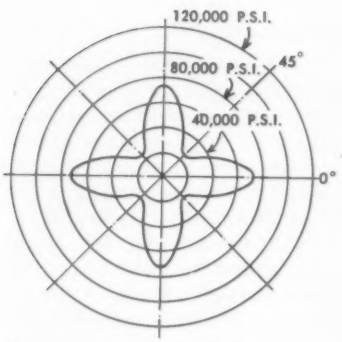


Fig. 3: Tensile strength of crossplied Type 1002 Scotchply versus applied stress angle. Reinforcement runs along horizontal and vertical axes

strengths possible with preferred orientation of the reinforcing fiber. From the designer's standpoint, fishing rods were a very pretty example of the power of preferred orientation since they are uniaxially stressed in a very simple fashion. For the fabricator they were easy, too.

In most structures, however, the stress system is more complex and loose fibers are not easily handled to meet these complex stress distributions with perfectly matched—or at least optimum—strength distributions. To meet the need for a class of reinforcing materials that permits the fabricator to make economically what the designer wants, the Scotchply line was developed.

Oriented filaments: effect on design

Since the mechanical strength properties of a reinforced resin matrix are essentially those of the reinforcing filaments in their lengthwise direction, it is obvious that the direction of these filaments will have a profound influence on the over-all mechanical properties of the molded plastic.

In Fig. 1, p. 133, is diagrammed a flat sheet of reinforced plastic in which all the filaments lie in a single plane and in parallel alignment. This sheet, when stressed in pure tension, will be found to have in the lengthwise direction of the filaments, a maximum tensile strength of 117,000 p.s.i., as seen in Fig. 2, above. (By plotting these tensile strengths in various angular positions about an axis perpendicular to the sheet, a polar chart results which shows the directional strength properties of a unidirectionally reinforced plastic stressed in tension.) As the direction of stress is varied from the direction of reinforcement, the tensile strength decreases sharply until at a stress angle of 90° from the filament direction the stress is only 2900 p.s.i.

Now, obviously, if stresses in other directions are anticipated, it is necessary only to align some of the filaments in these directions to greatly change the shape of the curve. Figure 3, below, shows the results of equal numbers of filaments lying in two directions at 90° to each other; and, to carry this thinking to its ultimate, three filament directions of equal angular displacement will produce a nearly isotropically-reinforced sheet which has strength over 40,000 p.s.i. in all directions about the axis, as in Fig. 4, left.

In visualizing the concept of reinforcing filaments oriented in a specific pattern to carry calculated stresses, it is important to appreciate the value of a laminated construction. It is known that for a given load on a particular stressed member, the stresses are not the same throughout the cross-section of the member. In a laminated member it is possible to tailor the reinforcement both in amount and in direction to limit strain to a desired minimum in the various parts of the load-carrying member. The result approaches ultimate efficiency both from the economical and strength-vs.-weight standpoints.

Tensile strength, however, is not the only property affected by filament direction. Table I, opposite, shows how other strength properties vary with the angle of stress in materials of specific filament orientation. Laminates which contain a somewhat isotropic reinforcement show almost equal mechanical properties in any of three stress directions. On the other hand, materials which are reinforced in only one or two directions show weakness at certain stress angles. Yet this so-called "weakness" is what provides the additional strength in other directions, with the same amount of reinforcement. At a constant resin-to-glass ratio of 35% to 65%, any glass not needed in one specific direction may be oriented to work in some other direction. Thus, so-called "weaknesses"

actually contribute to the high performance of a part made from an oriented material.

In a pressure vessel

For example, if a pressure vessel were to be designed which was cylindrical in shape with hemispherical ends, and it was to be made of a homogeneous material, design would be for the greatest stress in any particular direction. The result would be over-design in all areas where the maximum stress was not present. If a laminated material reinforced with longitudinal filaments were used, the designer could consider each stress and the direction of that stress.

A long cylindrical vessel under internal pressure is a good example of unequal stresses in two directions. The hoop stress, or stress around the circumference of the vessel, is given by $\delta_c = pr/t$, where

p = the internal pressure
r = the inside radius of the pipe
t = the wall thickness

The stress in the longitudinal direction,[1] on the other hand, is only half this value, i.e., $pr/2t$. The ideal material for this vessel, therefore, would be one having twice the strength in the circumferential direction as it has in the lengthwise direction. Tape reinforcement, in contrast to isotropic materials, can easily meet this requirement.

Tensile stress within a hollow sphere, per lineal unit of the shell, is equal to pr divided by 2t, and is the same in all the circumferential directions. Therefore the logical choice of strength orientation in the hemispherical ends of a pressure vessel would be to have equal strength in all directions, so the isotropic material would be used.

As ply-to-ply shear strength in the neighborhood of 5000 to 6000 p.s.i. is obtained with the material under discussion, the ends could be attached to the body of the vessel at the time of molding by alternate overlapping of plies. If, however, it was desired to fabricate the ends and body separately, it would be possible to make an

(*To page* 138)

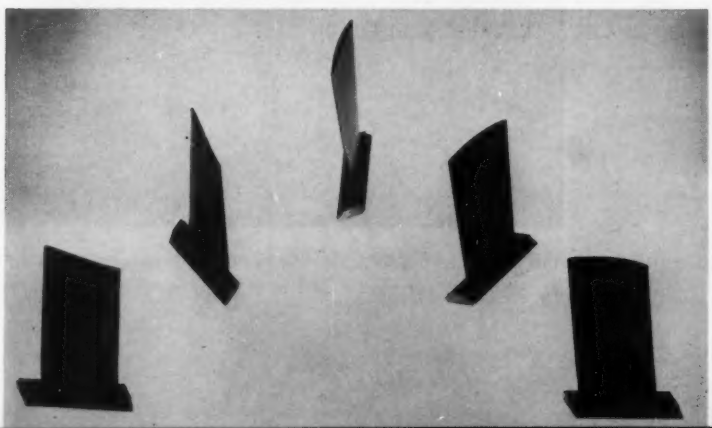
[1] Proof of these formulas may be found in any book on strength of materials, e.g., "Strength of Materials" 2nd Ed., Vol. 1, p. 42, D. Van Nostrand Co., New York (1940).

Table I: Mechanical properties of directionally reinforced plastic[a] at various stress angles (at 70° F.)

	Stress angle, degrees		
	0	45	90
Unidirectional, filaments in 0° direction			
Flexural strength[b], 10^3 p.s.i.	143.3	17.7	7.0
Modulus in flexure, 10^6 p.s.i.	5.7	2.0	1.6
Tensile strength[b], 10^3 p.s.i.	117.0	3.6	2.9
Modulus in tension, 10^6 p.s.i.	5.9		
Compressive strength[b], edge, 10^3 p.s.i.	83.5	19.5	20.0
Izod impact (edgewise), ft.-lb./in. notch	60.8	6.82	0.91
Interlaminar single shear strength[c], 10^3 p.s.i.	4.32		
Crossplied, filaments in 0° and 90° directions			
Flexural strength, 10^3 p.s.i.	116.2	39.7	116.2
Modulus in flexure, 10^6 p.s.i	4.2	2.0	4.2
Tensile strength, 10^3 p.s.i.	72.7	22.3	72.7
Modulus in tension, 10^6 p.s.i.	3.9	1.6	3.9
Compressive strength, edge, 10^3 p.s.i.	59.5	22.7	59.5
Izod impact (edgewise), ft.-lb./in. notch	35.18	59.25	35.18
Interlaminar single shear strength[c], 10^3 p.s.i.	4.07		
Isotropic, filaments in 0°, 60°, 120° directions			
Flexural strength, 10^3 p.s.i.	78.6	73.0	78.6
Modulus in flexure, 10^6 p.s.i.	3.0	2.8	2.7
Tensile strength, 10^3 p.s.i.	57.2	42.9	42.8
Modulus in tension, 10^6 p.s.i.	2.6	2.9	2.9
Compressive strength, edge, 10^3 p.s.i.	48.3	51.1	51.4
Izod impact (edgewise), ft.-lb./in. notch	40.85	42.32	38.60
Interlaminar single shear strength[c], 10^3 p.s.i.	3.75		

[a] Scotchply Type 1002, containing 35% glass and 65% epoxy resin, cured at 25 p.s.i. and 330° F. for 30 minutes. Test specimens were cut from ⅛-in.-thick laminates.
[b] Strengths are ultimate strengths; yield strengths are only slightly lower.
[c] 3M test procedure

Fig. 5: Directionally reinforced plastic turbine blades. Overall thickness and weight of blades was minimized by selective reinforcement, which puts greatest strength at those points where the stresses to be applied are the highest



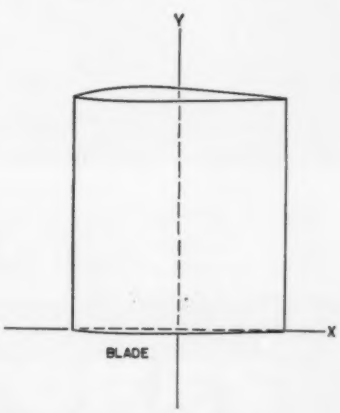


Fig. 6: Coordinate system for discussion of turbine blade design factors

Only one operator needed to supervise all seven Stokes Model 741 50-ton automatic compression presses at American Insulator Co.

This group of parts at ejection illustrates automatic molding versatility of the Model 741 in utilizing family dies (front view).

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The complete flexibility and ease of adaptation and changeover of the Stokes 741's enables American Insulator to bid successfully on an infinite variety of jobs—and to meet all customer specifications.

Continuous research and development has helped this company to achieve and retain a recognized leadership in the field of custom molding, enabling them to service the most difficult jobs.

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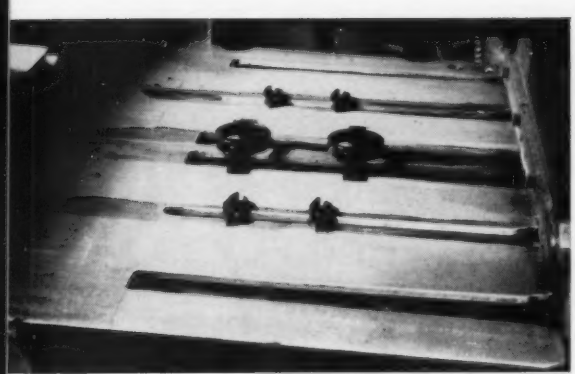
Press capacities of 50, 75, 125, and 200 tons are available. Write today for your copy of our new bulletin on the Model 741's, for a consultation on your requirements, and for a cost study on your specific application.



Positive ejection is assured by metal-to-metal seal between feed and comb.

Plastics Equipment Division
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adhesive bond between these members and realize shear strengths of approximately 2000 to 2500 p.s.i.

In reviewing this hypothetical design, then, it is found that strength is provided only where strength is needed and, as pointed out earlier, maximum efficiency has been approached in the use of materials.

In a spring

A second example of the design advantages obtained by orienting reinforcement is illustrated in the design of a spring. For the sake of simplicity, this spring can be assumed to be a spring of the flat leaf type.

In determining the usefulness of a spring material, both strength and modulus are important since the one determines the size of spring needed to support a given loading, while the other enters into the "spring constant" (deformation per unit load). The ratio of the two quantities, or S/E, is in itself important since it is a measure of the allowable strain in a simple axial tension or compression spring. Similar ratios, involving fractional and higher powers of *S* and *E*, are indexes of the allowable strain in leaf springs and under vibration or impact loading. These allowable strain ratios are listed below:

Type of spring	*Type of loading*	*Allowable strain index*
axial	static	S/E
axial	impact	S^2/E
leaf	vibration under fixed load	$S/E^{2/3}$
leaf	vibration with impact loading	$S^2/E^{4/3}$

In considering the design of a spring, it is obvious in all these relationships that as *S* increases, the allowable strain increases, providing *E* is kept constant. Table I shows that flexural strength is by far greatest in a unidirectionally reinforced material if the stress angle is designed to be zero. Since the various allowable strain indexes are very nearly equal for unidirectional and crossplied material in the 0° direction, and since the unidirectional material has the greater strength, it will be better as a spring material. Strength and modulus are both low in the isotropic material, so it cannot compete with the other two in this application.

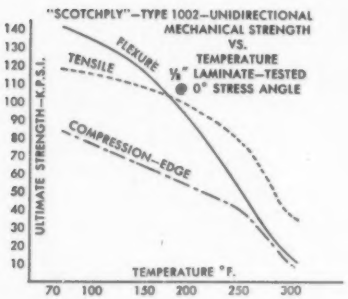
Although a unidirectionally reinforced leaf spring is perfectly possible to make with this new molding medium, handling and fabricating stresses require some crosswise reinforcement. This is generally accomplished by providing transverse reinforcement on the surface of the leaf spring. One layer of transverse filaments usually suffices.

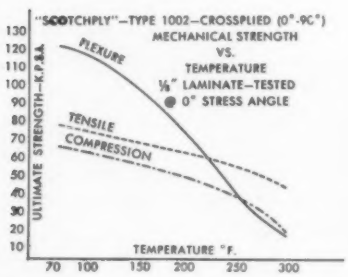
This discussion of spring design has been deliberately oversimplified for the sake of clarity. More detailed analysis of spring design factors is beyond the scope of this article. However, we will return again to these strain functions in comparing Scotchply with steel as a spring material.

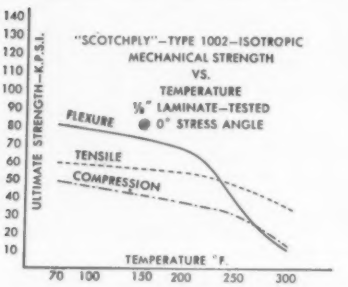
In a fan blade

Dynamically loaded structures, which usually have very complex stress patterns, offer another promising field for directionally reinforced plastics. A good example is a fan blade for an axial-flow, multistage compressor (Fig. 5, p. 135). In considering it, stresses due to vibration, temperature changes, etc., will be ignored for the sake of simplicity, and only the major forces will be considered.

Consider the blade to be placed in the coordinate system shown in Fig. 6, p. 135. Centrifugal forces set up tensile stresses in the *y* direction, while the impact of the air against the face of the







Figs. 7, 8, 9: Ultimate strength versus temperature for three standard materials, as identified in the graphs. In all three cases, there is at least some reinforcement in the 0° direction. All of these materials retain a substantial percentage of their room-temperature properties at 250° F.

Table II: Allowable strain comparison[a]

Spring type and loading	*Strain function*	*Chrome (H.T.) steel*		*"Scotchply" reinforced plastic—unidirectional Type 1002*	
		Theoretical	*Actual*	*Theoretical*	*Actual*
Axial	$S/E \times 10^{-3}$	3.3	1.33	5.8	5.1
Axial-impact	S^2/E	330	53	193	150
Leaf	$S/E^{2/3}$	1.04	0.41	1.04	0.92
Leaf with impact	$S^2/E^{4/3}$	1.07	0.17	1.07	0.83

[a] Source: Dr. B. J. Lazan, Professor and Head, Mechanical & Materials Dept., University of Minnesota. Actual values are based on fatigue strengths at 20 million cycles of stress.

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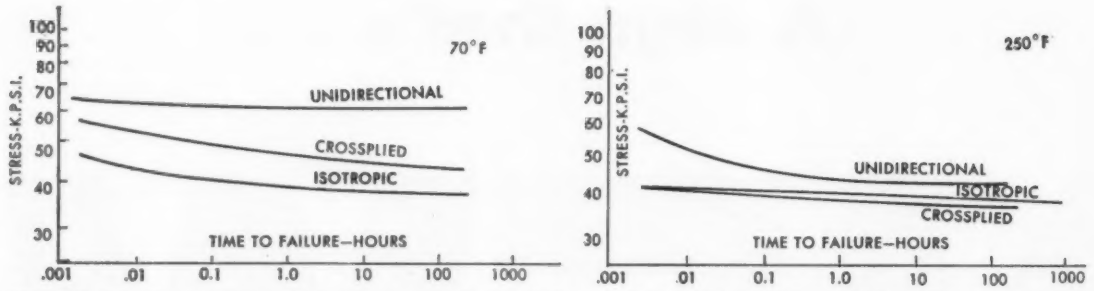


Fig. 10, 11: Rupture stress in tension versus time to failure of standard Type 1002 materials at 70 and 250° F. Isotropic material suffers very little loss of long-time strength at higher temperature. All three materials are about equivalent, strengthwise, in prolonged service at high temperature

blade tends to bend it out of the x,y plane, causing tensile and compressive stresses due to bending to develop in the y direction. While on one face the tensile and compressive stresses will tend to offset each other, on the other two tensile stresses will augment each other. Stress in both faces can be resisted by reinforcing the plastic laminate with filaments running parallel to the y axis. Transverse bending stresses due to the passage of gas over the airfoil surface of the fan blade can be met with reinforcing filaments parallel to the x axis. But this is not all: the thrust which caused the vertical bending moment also combines with the transverse moment to produce a torque tending to rotate the blade about the y axis. Filaments oriented at 45° and 315° to the y axis will resist these torsional stresses.

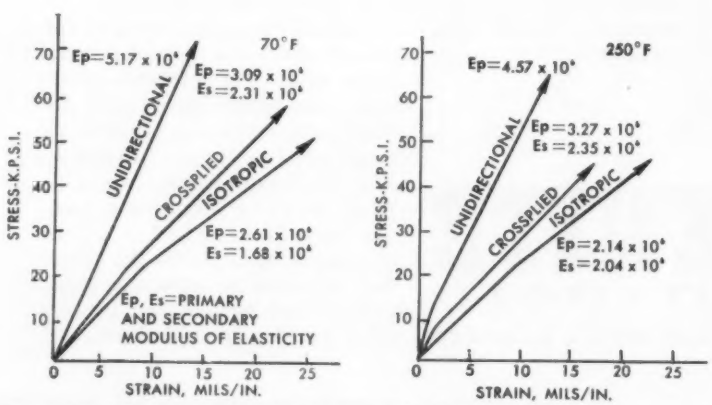
In a problem such as this, it is found that the stresses change at different distances from the so-called "neutral axis" throughout the cross-section of the part. Care should be taken to place filaments of any particular orientation in such a way as to use their strength efficiently. Also, in this case one face of the blade (under double tension) will need more reinforcement in the y direction than the other, so the other can have a greater share of the torsion-resisting filaments at angles to the y axis. A choice will have to be made in cases where stresses in different directions are at a maximum in the surface of the part, since it is not possible to locate filaments of different orientations in the same ply of material (or exactly the same plane). It is also worth remembering that filaments of a certain direction have *some* strength component at changing stress angles (Fig. 3 and Table I).

Testing for the designer

Designers must have data on properties and much standard test data is collected and published by material suppliers. Figures 2 through 4, 7 through 16, and Table I contain such information on the mechanical properties of moldings made of directionally reinforced epoxy resins.

Progressive manufacturers are also working with plastics fabricators to carry out simulated service testing as well as field testing programs. These efforts are, of course, much slower and more expensive than laboratory testing, and the data obtained are not generally applicable because of extraneous testing factors which field conditions introduce. Such tests do, however, reveal flaws, if any, in the designer's predictions, which were based on the laboratory evidence. Simulated service testing and model experimentation are particularly necessary in cases such as that of the fan blade previously discussed, where the stress distribution is very complex.

Field testing already completed and correlated with laboratory test values points up one interesting and highly significant fact: many reinforced plastics materials are much less vulnerable to environmental conditions than metallic alloys. These conditions—fretting, corrosion, notch sensitivity, etc.—tend to make practical strength values considerably lower than those obtained in the laboratory. Another point in favor of glass-reinforced plastics is that their elastic limits are close to their ultimate strengths, while in



Figs. 12, 13: Tensile stress/strain curves for Type 1002 materials show that there is little change in moduli as temperature is raised from 70 to 250° F. Note abrupt changes in slope of crossplied and isotropic materials

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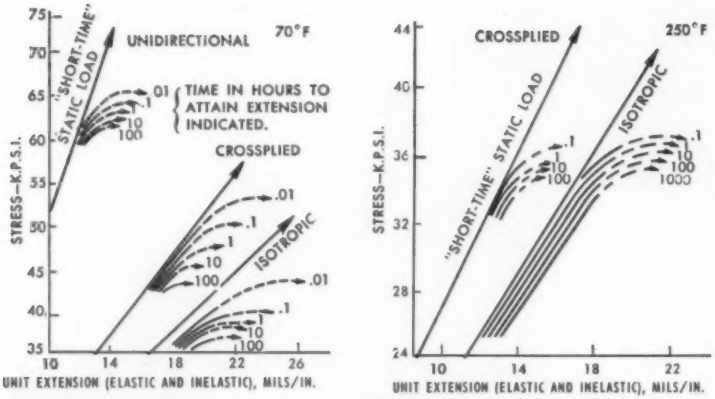


Figs. 14, 15: Tensile creep curves at 70 and 250° F. show that unidirectional material creeps least, isotropic most. Note that lower part of scale is not shown

metals (except cast iron) the yield point is well below the ultimate strength.

Since nearly all engineering design is based on the assumption that the part will be stressed only within its elastic limit, and will suffer no permanent deformation, even the crossplied material of Table II offers a yield strength higher than that of many alloy steels. Of course, these strengths are reported on a volume basis, and where weight is important (and where *isn't* it?), directionally reinforced epoxies outclass most structural steels by a factor of four.

Strength in field is high

In the discussion of spring design, four functions of flexural strength and modulus were defined. Table II compares the laboratory and in-service values obtained for a heat-treated chrome steel with those obtained for a directionally reinforced plastic. Under field-test conditions, based on a fatigue life of 20 million cycles, it has been found that the actual strength values obtained with the heat-treated steel are much less than the theoretical values obtained by calculation from laboratory test results. In some cases, the actual values are only about one-sixth of the theoretical values. In the case of the reinforced plastics material, however, the drop-off from theoretical to actual is comparatively slight and in all cases the coefficients obtained are much higher than those for steel, even though the theoretical values would not indicate that such a superiority would be obtained in practice.[2]

The closeness of agreement between laboratory test values and field experiences is enhanced by an unusual degree of lot-to-lot uniformity in the reinforced plastics materials. One manufacturer who has tested hundreds of samples both as part of a research program and as part of a quality-control program discovered that the coefficients of variation in mechanical properties from lot to lot run in the neighborhood of 2 to 6 percent. Metallurgists state that a mild steel, our most common structural engineering material, has a lot-to-lot variability of 6 to 8%, and that structural alloy steels are considerably worse in this respect since their properties are sensitive to tiny variations in composition. From the variability standpoint, the alloy steels are even more sensitive than mild steel to subsequent operations such as cold working and heat treatments.

There are many reasons for the excellent laboratory-field correlation of the reinforced plastics materials. A very important one is that the materials are furnished to the molder by the manufacturer in a ready-to-mold condition. Resin content and distribution, filament tension, filament direction, and material layup can all be precisely controlled and much of the human element removed by mechanical processes. Contrast this control with the many sources of variation afflicting the typical hand-layup job (particularly when mat is used). As more is learned about the behavior of such materials, more accuracy can be expected in predicting their performance. This should make it possible to reduce safety factors below those now in common use. This will improve the already high strength/weight ratio of these reinforced epoxy materials.

[2] Scotchply springs have successfully withstood 500 million cycles at comparatively high stress levels in magnetic vibrator spring applications.

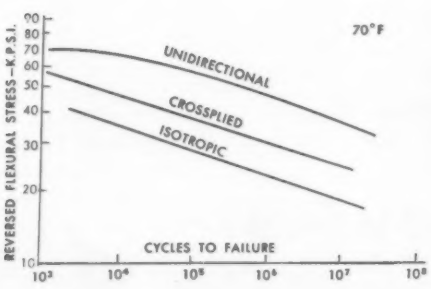


Fig. 16: Logarithmic flexural fatigue plots of stress versus number of cycles of reversed stress needed to cause failure. Data show one of the outstanding characteristics of unidirectionally reinforced Type 1002 as a spring material—its ability to withstand many millions of cycles at stresses over 30,000 p.s.i.

Chemical, electrical, and thermal properties

These reinforced epoxy materials successfully resist attack by many solvents and reagents, including 30% sulfuric acid and 10% sodium hydroxide solution, airplane fuels, hydraulic fluids, alkanes, and alcohols. In 7 days' immersion at 70° F., the isotropic material picks up about 0.2% of distilled water, with a resultant change in thickness of that amount, and no loss of flexural strength.

Electrical properties at 73° F. of samples conditioned at 50% r.h. are as follows: volume resistivity is 1.0×10^{10} ohm-cm.; dielectric

(*To page* 279)

New test for tool wear in machining thermosets

*By A. P. Landall**

The test described here removes the element of personal opinion in rating thermosetting materials as to tool wear. It consists of drilling a series of holes in molded samples under constant load and determining the difference between the times required to drill the last and first holes. Averaging the differences for four series of holes gives the tool wear index (TWI) in seconds, with 95% confidence limits of ± 10 percent. Several years of field experience have borne out the validity of the test. The use of the TWI in studying factors contributing to cutting tool wear and in developing low-wear molding compounds is demonstrated.

Tool wear has long been a problem in the machining of thermosets, and, in a vague way, it is known that some compositions are worse than others in this respect. Mica- and asbestos-filled materials, for example, cause cutting tools to wear much more rapidly than do general-purpose materials. But there was evidence to indicate that there are also real differences between the various grades of general-purpose formulations. In the absence of a precise, meaningful measure of tool wear, the personal experiences of finishing room foremen and others have given rise to many differences of opinion on how various compositions rate with respect to tool wear.

The work reported here was undertaken with three objectives: 1) to develop a reproducible and representative method of measuring tool wear, so that compositions might be rated impersonally; 2) to use this analytical method in investigating the factors that govern tool wear; and 3) using the method as a guide, to evolve molding materials that would be easier on cutting tools used in machining thermosets.

* Supervisor, Technical Service, Chemical Material Dept., General Electric Co., Pittsfield, Mass.

The test method

In trying to develop a test, several important considerations served as guides. First, the test should measure the desired property, and it was felt that an actual machining operation ought to be the basis of it. Second, it should be simple enough so that non-technical persons could be taught to perform it reliably with little instruction. Third, it should be reasonably fast. Finally, the equipment should, if possible, be inexpensive. From all these standpoints, a drilling operation seemed to be a good choice for the testing procedure.

Equipment. For the sake of controlling the applied load and the angle of contact between drill bit and sample, the drilling had to be done in a drill press. The one used was an inexpensive model, purchased locally. The drills used

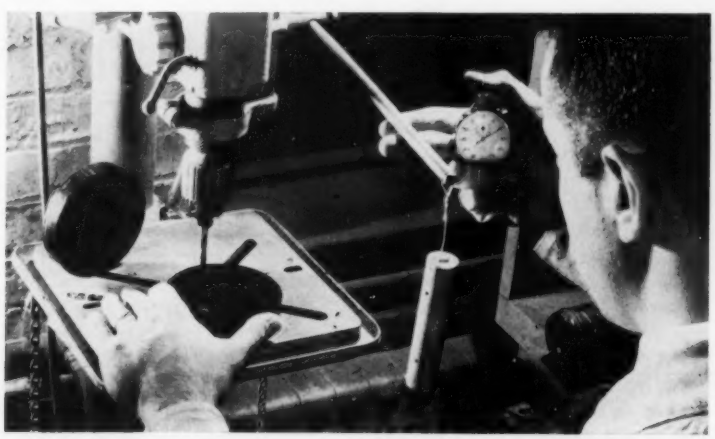


Fig. 1: Test operator drilling eleventh hole in second disk of phenolic compound. Two sets of 20 holes are drilled in each disk; time differences between first and 20th are averaged to give tool wear index. (Photos, General Electric)

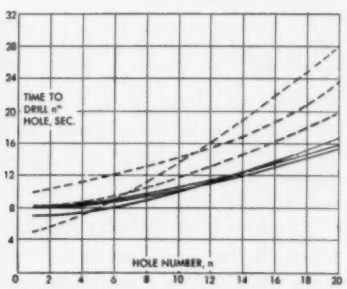


Fig. 2: Graph showing typical drilling-time curves for a phenolic formulation. Broken curves were obtained using new drills as received from maker, solid curves with drills properly sharpened before making test drillings. Presharpening greatly improves reproducibility of test.

Fig. 3: Operator presharpening test drills to prescribed angles

were No. 8, Bakelite-type, Cleforged high-speed steel, sold by the Cleveland Twist Drill Co. These drills are ground to a 90° included angle, with a rake angle of approximately 15 degrees.

The question arose as to whether it would be better to force the drill into the sample at some fixed rate of advance or to do the drilling under constant load. The constant-load method was adopted because it is simpler to accomplish, and, in this particular test, gives far more reproducible results. It was found that in order to get a representative cutting rate, a moment of about 10 in.-lb. must be applied to the arm of the drill press. A weight of 490 g. hung on the arm at about 10 in. from its pivot axis gave the desired moment. No other change was made in the press, which is shown in operation in Fig. 1, p. 143.

It was discovered that test reproducibility was much poorer with new drills than with resharpened ones (Fig. 2, p. 143), so every drill, new or used, was sharpened prior to using it in the test work. Sharpening, shown in Fig. 3, above, was done on a No. 1-G Sellers drill grinder, which is manufactured by Consolidated Machine Tool Corp., Rochester, N. Y.

Samples. The molded parts used in this test are 4-in. disks approximately ¾ in. thick. Each disk is molded in a positive mold for 20 min. at 330° F. from pills that have been electronically preheated to about 250° F. While it is perfectly feasible to use some other shape, it is essential that the same shape be used for all the samples if a valid comparison of *materials* is to be obtained by means of the test.

Procedure. In setting up the test, the first step is to release the spring actuating the quill return and to adjust the tension so that the quill barely returns under no-load conditions. Then the lever arm of the press is so adjusted that the starting position is between 7 and 15° above the horizontal position and the weight is attached.

The quill is locked in its starting position, a sharpened drill is inserted loosely into the chuck, and the drill is allowed to slip down (gently so as to preserve its point) until it just touches the sample. The chuck is tightened and the quill unlocked. This establishes the starting point for the test.

Stopwatch and drill are started together and the watch is stopped when the drill has penetrated ⅜ in., as indicated by a mark on the depth stop screw of the drill press. The sample is shifted, a new hole is drilled and the time recorded, as before. This operation is repeated either 10 or 20 times (depending on the wear rate), each hole being started with the motor at rest. In the same sample disk, another series of 10 or 20 holes is drilled with a resharpened drill. A second sample is then substituted and duplicate series of drillings are made. The final result is four sets of drilling times for each material tested. Each set can be plotted as a curve of drilling time versus number of holes drilled. The drilling-time curves shown in Fig. 5, below, are typical.

It was mentioned that either 10 or 20 holes are drilled with a single drill. In some materials, the drill is dulled so rapidly that drilling times become impractically

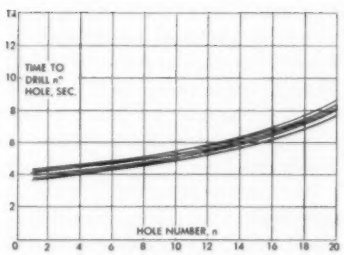


Fig. 4: Drilling-time curves for six successive runs in the same batch of general-purpose material. Each curve represents one series of 20 holes

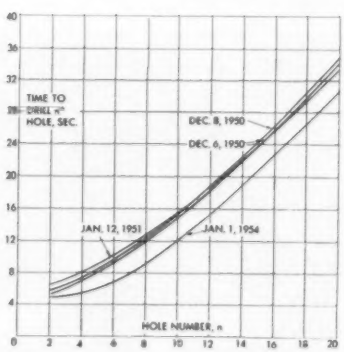
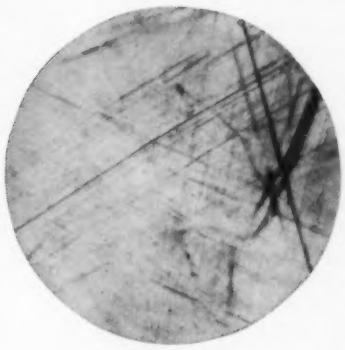


Fig. 5: Drilling-time curves obtained on different batches of the same formulation prepared over a three-year interval. While last batch seems a little softer than earlier ones, difference in tool wear index is negligible

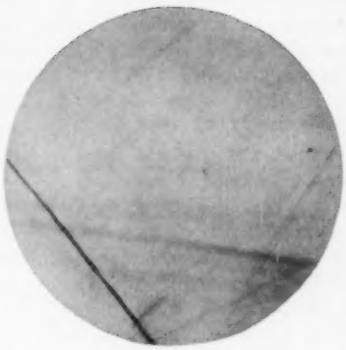
24 MONTHS OF FLORIDA EXPOSURE



UNEXPOSED

RESIN A

24 MONTHS' EXPOSURE



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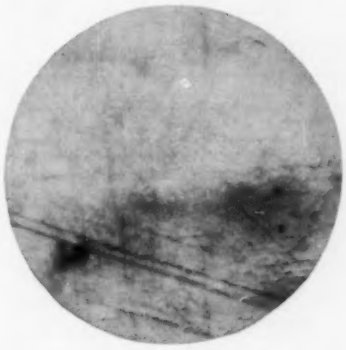

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RESIN B

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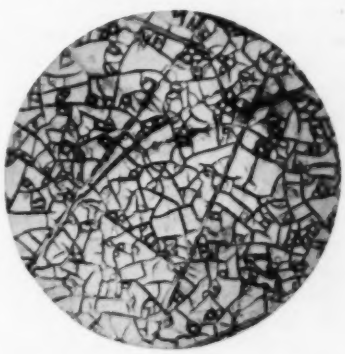

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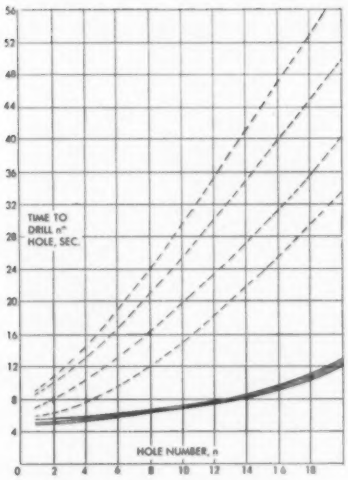


Fig. 6: Effect of resin content on tool wear rates. Solid lines are for standard resin at 45, 50, 55, and 60% levels, show no significant differences. Broken lines are very different at same changes in level. Resin in these cases contained abrasive aid to grindability

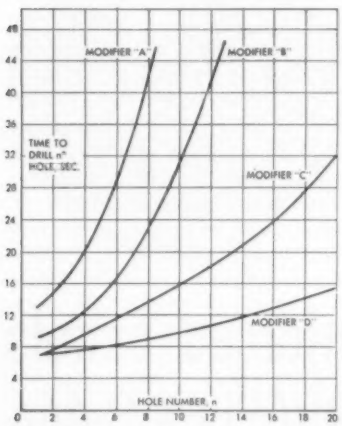


Fig. 7: Four filler modifiers (same filler/resin ratio in compound) have widely different effects on tool dulling rate

long. In such cases, ten holes will suffice. From these measurements, the difference in times required to drill the first and last holes (delta 20 when 20 holes are drilled or delta 10 for 10 holes) is calculated. The four values are averaged to get the tool wear index, or TWI. Since the graphs of Figs. 2, 4, etc., become increasingly more concave upwards as the number of holes drilled increases, and since the rates at which their concaveness increases are unequal, there is no simple relationship between the two time differences. It is therefore important to make clear whether delta 20 or delta 10 was used in computing the TWI.

Reproducibility of test

The six curves of Fig. 4 are the results of successive runs on a single material. The delta 20 values calculated from these runs range from 3.8 to 4.8 seconds. While these figures are indicative of the reproducibility of the test as made on a certain pair of duplicate test samples, it was suspected that variations over a period of time in operator technique or material formulation and molding might result in a wider spread of test results. The graphs of Fig. 5, which are the results of test runs on four different batches of this material made over an interval of about three years, show that such sources of variation do not increase the relative error of the test significantly. The 95% confidence limits for the TWI (average of four delta 20's) are about ±10%.

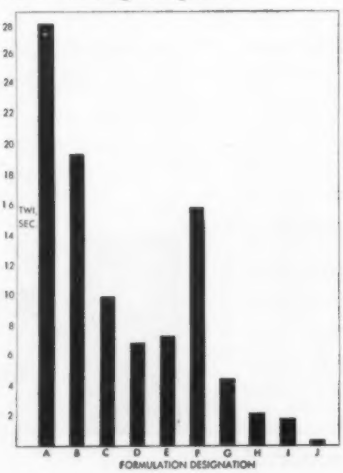
Tool wear vs. formulation

The effect on tool wear of resin content of phenolic compounds filled with wood flour made from soft woods is shown by the solid curves of Fig. 6. Over the range investigated, from 45 to 60% of standard resin, there is no significant change in tool wear. The dotted curves, on the other hand, are corresponding curves for a non-standard resin containing an additive intended to improve the grindability of the finished moldings. Obviously this abrasive additive hastens tool wear. Another finding of this phase of the work was that, insofar as tool wear is concerned, there are no significant differences among softwood flours bought from various suppliers.

Figure 7 shows the tool wear caused by moldings made from compounds containing equal amounts of different filler modifiers. Modifiers A and B are so destructive of tools that they should never be used when parts must be machined. Small amounts of C might be tolerated, but D gives the best chance for success in developing a low-wear grade of phenolic resin.

Figure 8 shows successive stages in the evolution of a low-wear composition, using the TWI as a guide. Not all the steps are shown, but the ones shown are in the proper sequence and are representative of the general pattern. From an initial value of 27.3 sec., the TWI was cut to a tiny $\frac{1}{10}$ of a second! Of course this was accomplished at some sacrifice of hardness in the finished product, and when scratch resistance is important, a balance between that property and tool wear must be reached.

Fig. 8: Successive steps in the evolution of a low-wear, general-purpose phenolic molding compound



As more was learned about the contribution of the various filler ingredients to cutting tool wear, it was possible to improve the TWI of the various grades of phenolic resins marketed by General Electric. These improvements have without exception been confirmed over the past several years by field experience in machining these compounds. Thus the TWI seems to be not only reproducible, but also representative. It should be applicable to other thermosetting materials and, with modification, perhaps even to thermoplastics. It deserves a useful place among plastics test methods. It should also be an aid to machiners of plastics in establishing work schedules and tooling needs.

Cast mold cavities

*By Irwin Lubalin**

Utilizing a unique refractory mixture that passes through a rubbery stage before it is cured and does not expand when heated, the Shaw process is capable of making dense, solid castings of almost any intricacy from virtually all castable alloys. The process requires relatively low investment, cuts material costs and inventories, and can easily yield a finished mold in a day. It is likely to be more expensive than hobbing where more than two identical (hobbable) cavities are wanted, and does not compete with machining when the cavity is simple and easily machined. Dimensions may be held to ±3 mils/in. on castings in the 30-lb. range; surface finish is about 70 microinches.

The Shaw process, a new casting technique that has been in use for some time in England, is now proving itself in the U. S. to be an attractive method of making steel and beryllium-copper tools for injection and compression molding.

A novel refractory mixture is the basis of the process, which yields large or small precision castings without the necessity of using an expendable pattern. The process is fast: starting with a finished pattern, or model, of the object it is desired to mold, it takes less than a day to produce a finished mold cavity, and, under ideal conditions, it may even be accomplished in a single working shift. While other methods for making cavities may under some circumstances be more economical—hobbing, for example, when a number of identical cavities are to be made—the new casting process has great versatility. Any cavity that can be made by other known processes is technically feasible with the Shaw process (Fig. 1, below). It is quite possibly the *only* way to make intricate cavities that are too delicate to hob or too difficult and expensive to machine (Fig. 2, p. 148). Even some degree of undercut is tolerable in the Shaw mold. Where hobbing is indicated, the Shaw process is excellent for casting the hob. Because no machining, but only polishing, of the cast cavity surfaces is required, it is possible to make cavities of alloys that are so hard as to be unhobbable and unmachinable. Castings can also be made of alloys incapable of being electroformed. Castings are non-porous and dense; some Shaw-cast forging dies have had three or four times the working life of dies machined from the same tool steel.

*General Mgr., Shaw Process Development Corp., Div. of British Industries Corp. Port Washington, N. Y.

The process

The first step in making a Shaw-cast mold cavity is preparing the model (Fig. 3, p. 148). This may be a duplicate of the product to be molded and made of plaster, wood, plastic, metal, etc., with a suitable allowance for shrinkage of the cast metal, or even a plastic or plaster molding made from a duplicate cavity. Where a hob is to be made for beryllium-copper pressure castings or steel hobbings, a negative model is used. The pattern must be made carefully, since any flaw in it will be

Fig. 1. These assorted mold cavities demonstrate the versatility and fidelity of the Shaw casting process. (Photos 1 through 8, Shaw Process Development Corp.)

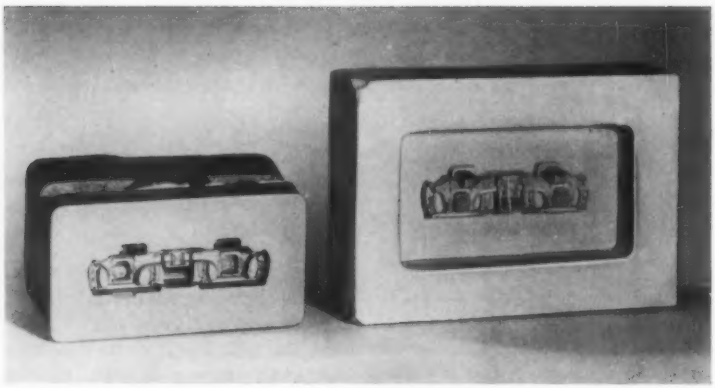


Fig. 2. This intricate cavity (left) for a model train truck side would have been impossible to hob in steel and would have required many hours of painstaking machining. The corresponding Shaw mold, slurry-cast around a speciment train truck, is shown at the right

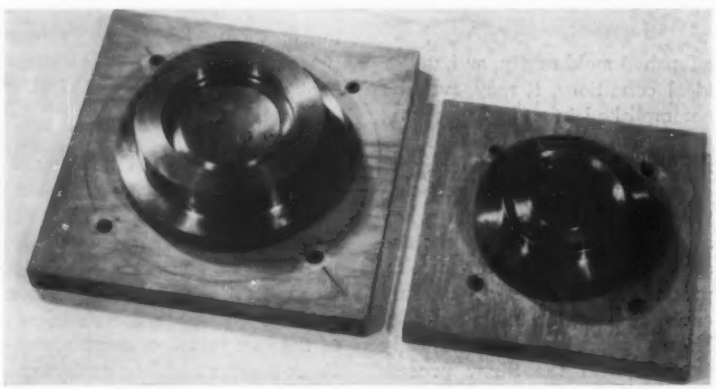


Fig. 3. Reverse patterns for cavity of toothed wheel mold are made of brass fastened to plywood. Figs. 4 through 8 show steps followed in duplicating these patterns first in the Shaw mold, then in tough steel

faithfully reproduced in the cast cavity.

A slurry of refractory material is mixed with a binder liquid containing mainly ethyl silicate and a gelling agent that controls the gel-set time of the mixture. This slurry is poured over the model (Fig. 4, below) and permitted to set for a short time until it attains the consistency of vulcanized rubber. In this state it is both flexible and strong enough to be stripped from the model, even if there are moderate undercuts (Fig. 5, below). It should be stripped gently, however, since excessive tension may rupture the gel at points of stress concentration, with resulting cracks in the cured mold.

The next step is ignition and baking out of the mold, to yield the hard, refractory receptacle for the molten metal. It is in this step that the uniqueness of the process shows itself. By deliberately subjecting the gelled mass to heat shock, the mold is finely crazed throughout but there are no large cracks. As the gelled binder is burned off, the resulting minute particles of silica are left between the larger particles of refractory material.

The result is a finely porous, three-dimensional network resembling, on a microscopic scale, a pile of rocks separated and bonded by grains of sand. Each refractory particle is separated

Fig. 4. Patterns are blocked up in adjustable slurry box and Shaw slurry is poured. Some stirring and tapping brings up air bubbles, insures perfect reproduction

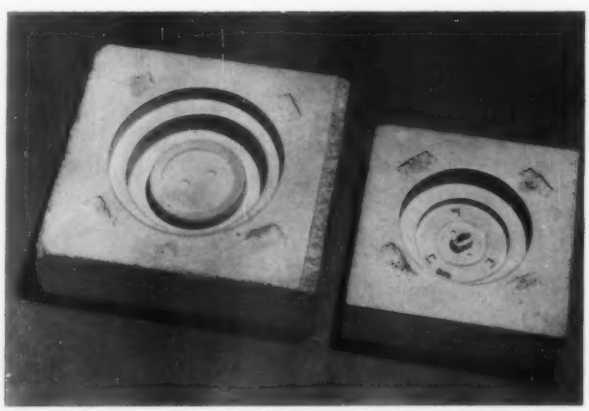


Fig. 5. The refractory slurry mixture gels and becomes firm and rubbery. Here the gelled molds have just been stripped from the pattern. Next they are ignited with a torch, and when most of the flammable volatiles have burned off, the molds are transferred to the bake-out oven

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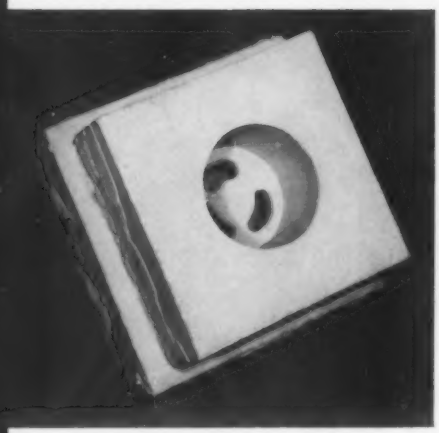


Fig. 6. The same mold after a pouring riser has been cemented onto it with more of the slurry. This mold has been through bake-out

Fig. 7. The mold is clamped to the outlet of a 20-lb., indirect-arc furnace containing a crucible full of molten steel. When it reaches the proper temperature, the furnace is inverted, as in this photo, and the mold is completely filled with exactly the required amount of steel

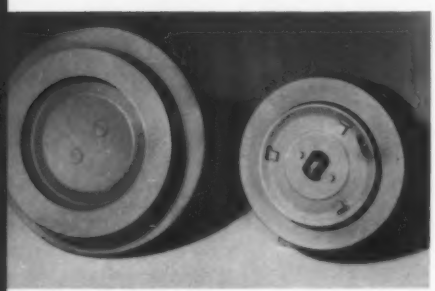


Fig. 8. The new castings are broken out of the Shaw mold and sand-blasted to remove edge burrs. Note the sharpness of reproduction in these "as cast" tools and the smooth finish in the difficult-to-polish center of the core section at right

from its neighbor by a minute fissure. When the cold mold is subjected to the thermal shock of being filled with molten metal, each particle expands. In so doing it merely fills part of the gap between itself and its neighbor, and there is no expansion on the macroscopic scale. Result: the mold accepts the hot metal without cracking.

This resistance to thermal shock also makes the mold completely stable dimensionally. A pattern will fit back into a Shaw mold hot or cold, except perhaps in large molds with wide variations in wall thickness. This behavior is the reason for the extreme accuracy and fidelity obtainable. Since no intermediate cast pattern is used, as in the lost-wax process, the Shaw process is not subject to dimensional variations arising from wax shrinkage or distortion.

Baking out

Ignition and bake-out account for most of the time needed to make a Shaw mold. In baking out, molds are brought to a red heat in order to insure complete removal of the volatiles. The time required at red heat is short but it may take several hours to bring a large mold up to that temperature, particularly if the oven used is cold at the start.

From the standpoint of fast production, it is advisable to have an oven that can reach that temperature quickly and maintain it easily. If the oven is already hot, it is possible to have a small cavity or core pattern arrive at the caster's premises in the morning and have the steel die cavity shipped out on the afternoon of the same day.

After being baked out the mold is ready to receive the molten metal (Figs. 6 and 7, above). The resulting casting has a surface finish of about 60 to 80 microinches, which may be compared with the 150 to 200-microinch finish characteristic of most machining operations used in mold making, e.g., milling and pantographing. Thus, Shaw molds require considerably less polishing and finishing time than do steel molds machined from the same steel (Fig. 8, left). For some molding jobs, where a matte finish is desired, the Shaw mold can be used in the as-cast condition.

In typical castings, a hefty percentage of the cast metal ends up in the risers through which the mold is filled. This can all be reclaimed, so that the scrap rate is very low. Rework rates of 60% are reported by a number of licensees.

Where many different alloys are being handled in one shop, it is wise to stamp each riser as soon as it has cooled so that its identity is not lost. Since there is almost no scrap, and since steel for casting costs about half as much as the same steel in bar stock, overall material cost is about ⅓ that of die-sunk cavities. All raw materials can be stocked in the single form of shot, so there is no waiting for out-of-stock block sizes and inventory is reduced. The finest tool steels may be used, especially important in compression-molding tools, and most of these will take heat treatment to a hardness of 50 to 60 Rockwell C. Deformation in heat treating is generally less than that encountered in heat-treating deep machined cavities.

Shaw castings have been used in aircraft and have been proved sound by X-ray and Zyglow inspection. Beryllium castings are considerably sounder than those produced by conventional beryllium casting methods, though not quite as dense as pressure beryllium cast.

As long as patterns are kept,

replacement cavities can be made quickly in case of a breakdown in the mold (Fig. 9, below).

While most molds are made with one-plane parting lines, complex parting lines are almost as easy to produce by the Shaw process as straight ones (Fig. 10, below). Polishing is more tedious, of course. It is possible that in the future entire molds, complete with runners, gates, cold wells, vents, and cooling channels, may be cast by this method. This has already been tried successfully with die-casting molds.

Limitations

While any otherwise fabricable cavity can be made by the Shaw process, it is usually uneconomical to cast simple cavities that can easily be hobbed, turned, or milled. This is especially true where more than two cavities of a hobbable material are wanted. Similarly, it may sometimes be almost as easy to machine a cavity as a model, and casting would certainly be the long way around in such a case.

Like any casting process, this one is subject to variations in steel shrinkage. Any particular one-inch length can be held within a tolerance of ±3 mils. In large castings, however, the overall tolerance on long dimensions is closer than this figure would indicate. The total error can generally be under ±10 mils.

Where closer tolerances must be met, it will be necessary to leave a small allowance for final grinding to required dimensions. In such cases, straight machining or hobbing may be the more economical manufacturing method. Each case must be judged on its own requirements.

Equipment needed

One of the attractive features of the process is the relatively small investment required for the equipment. A steel melting furnace, a bake-out furnace, and a sandblast unit comprise the entire capital equipment needed, though some auxiliaries (such as scrap cutting equipment) may be desirable. Of course, steel melting equipment for large castings can be costly. On the other hand, beryllium-copper melting equipment, even for large castings, is not nearly so expensive. The total cost of equipment for making castings up to 200 lb. should run between $15,000 and $30,000. Most of the castings shown in the accompanying photographs were produced with less expensive equipment having capacities well below 200 pounds.

Fig. 9. All the cavities and center inserts for this 12-cavity high-heel mold are Shaw castings, subsequently polished. A damaged cavity can easily be replaced as long as the pattern is available. (Photo, Osley-Whitney Co., Westfield, Mass.)

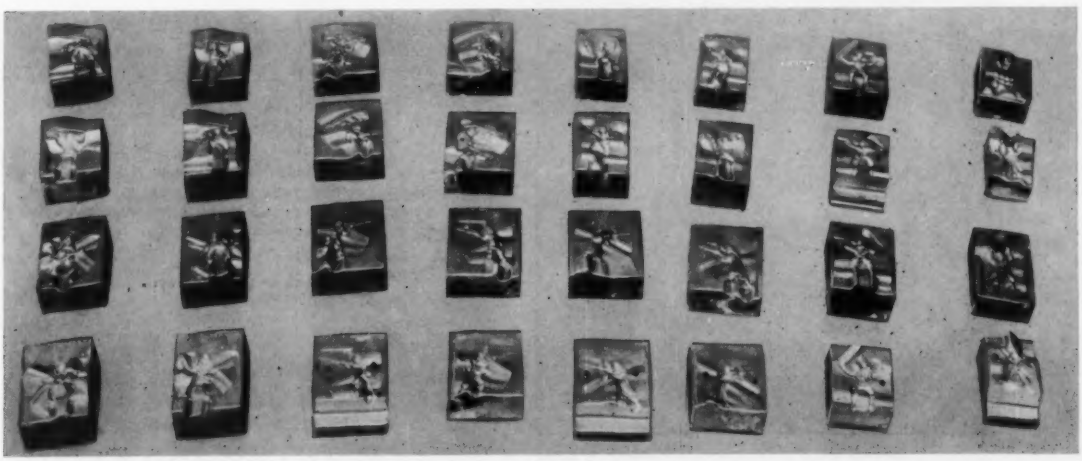
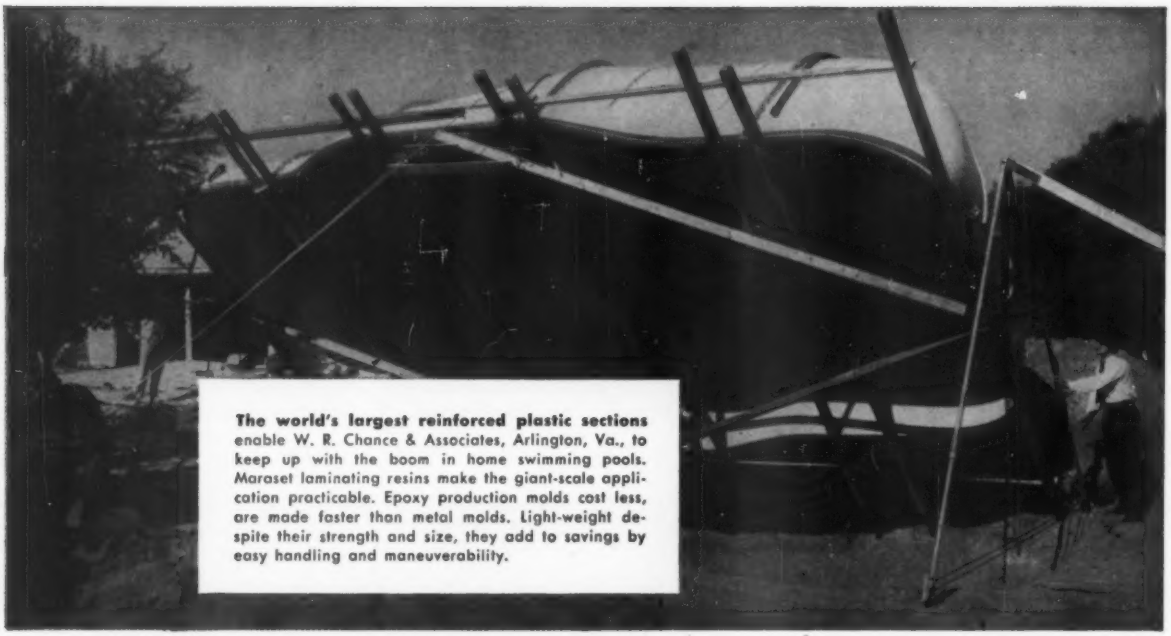


Fig. 10. A series of pressure cast berylium cavities and the Shaw-cast steel hobs from which they were made. Hobs are in second and fourth rows from bottom. Cavities were cast from hobs because many of each were wanted. Note the freedom with which parting lines meander. (Photo, Standard Tool Co., Leominster, Mass.)



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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Properties of polyester-triallylcyanurate glass-reinforced laminates at elevated temperatures

By Norman E. Wahl† and Harold M. Preston†

The tendency of commercially available triallylcyanurate resins to crack upon postcure and to become thermally degraded after exposure to 500° F. for periods up to 200 hr. was investigated. These studies indicate that the cracking of these resins is severe. The cracking of the laminates can be attributed to the cross-linking of the triallylcyanurate monomer. No correlation between the amount of cracking and water absorption was found.

While the degradation of the laminates was greatly reduced when they were cured and heat-aged in an inert atmosphere of nitrogen, it was found that the cracking was not eliminated or significantly reduced.

A study of the influence of inert pigments as fillers to reduce the cracking showed that although the cracking was not eliminated, it was materially reduced with 40% of pigment. In general, the flexural strength of laminates using 40% of carbonate fillers, based upon the weight of the resin, was comparable to the unfilled laminates. The most satisfactory pigment of those investigated was Surfex MM, a treated calcium carbonate filler.

The use of a 0.010-in. thick overlay of asbestos felt on both surfaces of a ⅛-in. thick 181-301 glass-reinforced laminate eliminated cracking and reduced the thermal degradation as well as the water absorption. This system appeared to be the most practical solution to the problem of cracking.

A study of the properties of polyester triallylcyanurate resin laminates has shown that these materials are generally satisfactory and "void free" when cured at temperatures of 175 to 200° F., but when postcured in a temperature range of 400 to 500° F. the laminates usually become an opaque brown in color and acquire a dull rough surface. When exposed to high humidity, they absorb over 3% by weight of water with resulting deleterious effect on electrical properties. Postcuring is required to obtain maximum strength and heat resistance of the triallylcyanurate glass-reinforced laminates. Examination of the surface of these postcured laminates with a low-power microscope reveals the fact that the roughened surface is due to an extremely high degree of cracking of the resin. This work is concerned with a study of this phenomenon of cracking and methods of eliminating it.

Evaluation of triallylcyanurate resins

Triallylcyanurate has three alkene groups symmetrically substituted on a triazine ring. Its high functionality apparently helps to encourage cross-linking with alkyds which results in resins with greater thermal stability and good strength retention at elevated temperatures. Upon polymerization of this copolymer, the shrinkage and extreme brittleness of the triallylcyanurate monomer tends to cause cracking of the resin.

A variety of modified alkyds were studied to overcome this inherent brittleness and to reduce the cracking tendency of triallylcyanurate monomer but these flexible alkyd resins tend to lower the strength of the result-

*Reg. U.S. Pat. Off.

†Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y. Most of the work reported here was sponsored by the Materials Laboratory, Directorate of Research, Wright Air Development Center, USAF.

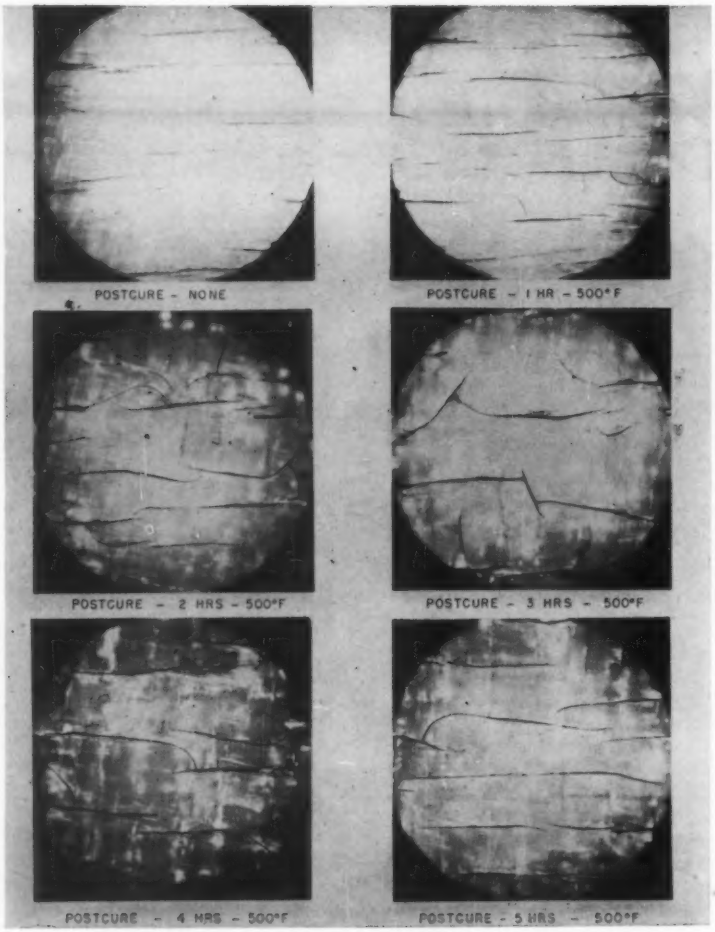

Fig 1: Photomicrographs (16X) of typical commercial triallylcyanurate polyester 181-301 laminates after 2-hr. cure in press at 220° F. and postcure noted underneath each specimen

ant copolymer at elevated temperatures and increase the thermal degradation. This approach was therefore abandoned and methods of reducing the cracking of commercially available resins were investigated.

There were three triallylcyanurate copolymers that were commercially available at the time this study was conducted: Vibrin 135 (Naugatuck Chemical Co.), Laminac 4232 (American Cyanamid Co.), and Selectron 5000-468-53 (Pittsburgh Plate Glass Co.).

Preparation and postcure

Glass-reinforced laminate panels, ⅛ by 18 by 19 in., were prepared from the three resins noted above using 12 plies of 181-cloth with a #301 finish. These panels were brought as closely as possible to their maximum strength by an initial cure in the press at 170° F. for periods ranging from 30 min. to 2 hr., and put in an air-circulating oven at 250° F. The oven temperature was raised in 50-degree increments to 400 or 500° F. If the postcure was carried out at 400° F., the laminate was held at this temperature for 24 hr.; this cure is denoted as Condition A. If the postcure was conducted at 500° F., the laminate was held at this temperature for 3 hr.; this cure is defined as Condition B.

The commercial triallylcyanurate resins were evaluated for use in elevated temperature applications by visual observation of the laminates and by measuring several physical properties of the carefully prepared laminates.

Fig. 1, left, shows a 16X photomicrograph of a glass-reinforced laminate made with a typical commercial triallylcyanurate resin. This micrograph shows that even when the cross-linking or copolymerization has not been completed, i.e., after 2 hr. press cure at 170 to 220° F. and no postcure, there are fine hair-like cracks developing. In postcuring or heat-aging of the laminates at 500° F., the cracks appear as isolated, usually parallel, hair-like fissures in the surface of the resin, in approximately 1 hour. As the postcuring time or exposure to a temperature of 500° F. is increased, the cracks become progressively larger and subsequently form a criss-cross pattern of hundreds of cracks extending throughout the laminate. This cracking is undoubtedly caused by the mechanical stress due to the different coefficients of thermal expansion of the glass reinforcement and the resin, as well as the previously mentioned chemical action or polymerization of the resin which causes molecular reorientation with consequent shrinkage.

Observation of the laminates made with these resins after the initial cure of 2 hr. at 170° F. in the press and 2 hr at 250° F. and 24 hr. at 400° F. (Condition A) in the oven, gave no evidence of cracking to the unaided eye and the laminate appeared smooth and a light tan in color. Examination under a 10X microscope, however, showed a few random, extremely fine, hairline cracks in the surface of the laminates. Upon further heat-aging for periods up to 48 hr. at 400° F., the laminates remained smooth in appearance but had turned a little darker in color. No cracks could be observed with the unaided eye. Examination under a 10X microscope showed that with these clear unfilled resins, the cracks had become only slightly larger and covered the entire laminate surface.

In general, the cracking characteristics of all the laminates made with commercially available resins were similar when exposed to the same conditions of heating.

It was also found that after postcuring and then further heat-aging at temperatures of 400 or

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Table I: Effect of elevated temperatures on glass-reinforced laminates with commercial triallylcyanurate resins

Resin	Ultimate flexural strength and modulus of elasticity, average — Room-temp. strength (75°F.) — After postcure for 24 hr. at 400°F.	Room-temp. strength (75°F.) — After aging 200 hr. at 500°F.	High temp. strength (500°F.) — After postcure for 24 hr. at 400°F.	High temp. strength (500°F.) — After aging 200 hr. at 500°F.
Vibrin 135				
Flexural strength, p.s.i.	52,300	25,400	18,500	17,400
Modulus of elasticity, 10^6 p.s.i.	2.8	2.2	2.1	1.2
Laminac 4232				
Flexural strength, p.s.i.	44,300	21,800	18,700	19,000
Modulus of elasticity, 10^6 p.s.i.	2.0	2.0	1.6	1.3
Selectron 5000-468-53				
Flexural strength, p.s.i.	47,900	28,400	11,200	17,100
Modulus of elasticity, 10^6 p.s.i.	2.9	2.1	1.5	0.7

	Heat deterioration, average weight loss — After 48 hr. at 400°F.	After 48 hr. at 500°F.
	%	%
Vibrin 135	1.0	6.0
Laminac 4232	2.5	7.6
Selectron 5000-468-53	2.9	6.6

	Water absorption after 24-hr. immersion, average — After 48 hr. at 400°F.	After 48 hr. at 500°F.
	%	%
Vibrin 135	0.7	3.4
Laminac 4232	3.0	5.1
Selectron 5000-468-53	2.6	3.8

Table II: Effect of postcure on water absorption and weight loss

Resin	Water absorption after 24-hr. immersion, average — After 48 hr. aging at 400°F.	After 48 hr. aging at 500°F.
	%	%
Laminac 4232[a]	3.0	5.1
Laminac 4232[b]	2.6	4.1
Selectron 5000-468-53[a]	2.6	3.3
Selectron 5000-468-53[b]	3.3	4.3
	Heat deterioration, average weight loss	
Laminac 4232[a]	2.5	10.1
Laminac 4232[b]	0.8	3.4
Selectron 5000-468-53[a]	2.9	6.6
Selectron 5000-468-53[b]	1.8	2.1

[a]Condition A cure [b]Condition B cure

500° F. for periods of up to 48 hr., the laminate specimens lost weight. This loss in weight was used as an indication of the degradation of the resinous portion of the laminate. After exposure to temperatures of 400 or 500° F. for 48 hr., the water absorption of these laminates after 24-hr. immersion was also used as an indication of the relative amount of cracking.

The flexural strength and modulus of elasticity after initial curing, i.e., Condition A or B, and further exposure to 400 or 500° F. was also used as a measure of the heat degradation of the laminates.

Early tests on these commercially available resins indicated that there was no significant change in the loss in weight, water absorption, or flexural strength of the laminate after initial cure (Condition A or B) and further exposure to temperatures of 400 or 500° F. for 0.5 hour. Based upon this finding, no further screening tests were conducted after 0.5 hr. at 400 and 500° F.

It was also found that the flexural strength of these triallylcyanurate resin laminates after initial cure (Condition A or B) was not significantly changed after 200 hr. additional exposure to 400° F. Further flexural tests at 400° F. were therefore eliminated in the evaluation of these resins.

The flexural strengths, modulus of elasticity, water absorption, and heat loss values obtained with these commercial resins are presented in Table I, above.

Some variation in tendency to blister as well as loss in weight, water absorption, and flexural strength was observed in testing various batches of the same commercial triallylcyanurate copolymer resins in glass-reinforced laminates.

One of the causes of this variation of physical properties was

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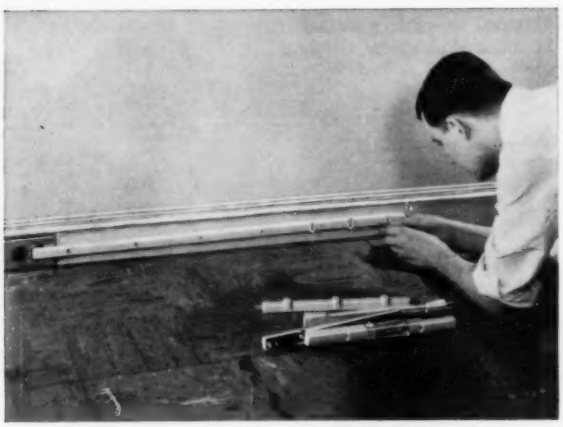

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Table III: Effect of postcure on ultimate flexural strength and modulus of elasticity of laminates (181-301 fabric, parallel laminated, tested flatwise)

Resin	Room temperature strength (75°F.) After postcure[a] for 3 hr. at 500°F.	Room temperature strength (75°F.) After aging 200 hr. at 500°F.	High temperature strength (500°F.) After postcure[a] for 3 hr. at 500°F.	High temperature strength (500°F.) After aging 200 hr. at 500°F.
Laminac 4232				
Flexural strength, p.s.i.	59,500	24,900	27,700	19,700
Modulus of elasticity, 10^6 p.s.i.	3.4	2.2	2.8	2.4
	After postcure[b] for 24 hr. at 400°F.	*After aging 200 hr. at 500°F.*	*After postcure[b] for 24 hr. at 400°F.*	*After aging 200 hr. at 500°F.*
Flexural strength, p.s.i.	44,300	21,800	18,700	19,000
Modulus of elasticity, 10^6 p.s.i.	2.0	2.0	1.6	1.3
	After postcure[b] for 3 hr. at 500°F.	*After aging 200 hr. at 500°F.*	*After postcure[b] for 3 hr. at 400°F.*	*After aging 200 hr. at 500°F.*
Selectron 5000-468-53				
Flexural strength, p.s.i.	48,800	31,000	24,700	24,500
Modulus of elasticity, 10^6 p.s.i.	2.5	2.3	2.0	1.8
	After postcure[a] for 24 hr. at 400°F.	*After aging 200 hr. at 500°F.*	*After postcure[a] for 24 hr. at 400°F.*	*After aging 200 hr. at 500°F.*
Flexural strength, p.s.i.	47,900	28,400	11,200	17,100
Modulus of elasticity, 10^6 p.s.i.	2.9	2.1	1.5	0.7

[a]Condition B
[b]Condition A

considered to be due to uncontrollable polymerization rates. To check this theory, the postcuring cycle of Vibrin 135, Laminac 4232, and Selectron 5000-468-53 was changed from 24 hr. at 400° F. (Condition A) to 3 hr. at 500° F. (Condition B).

As shown in Tables II, p. 156, and III, above, physical properties such as water absorption, heat loss, and flexural strength, were improved by this change in postcure temperature for Laminac 4232 and Selectron 5000-468-53. The Vibrin 135 laminates however, blistered badly when postcured at 500° F. for 3 hours.

It was subsequently found that by using 0.5% of di-*tert*-butyl peroxide and 0.5% of benzoyl peroxide as catalyst, instead of 1.0 to 2.0% benzoyl peroxide, blistering of the V-135 laminates was eliminated after a 3-hr. cure at 500° F. (Condition B).

This variation in data on the physical properties obtained in the same laboratory by the same technicians, indicates possible reasons for discordant results that have been obtained in interlaboratory comparisons on laminates made from these same heat-resistant resins.

During this work, it was also observed that the flexural strengths and flexural moduli of elasticity of these laminates were significantly higher, and the cracking and heat loss less, when the test specimens were laid flat on Transite sheet during the 200-hr. heat-aging cycle in an air-circulating oven. When specimens were placed upright in the oven so that the circulating air could carry away any gaseous products of decomposition, the cracking and loss in strength was considerably higher.

In all tests reported in this study, the specimens were placed upright in an oven during cure and heat-aging.

Influence of pigment fillers

It seemed desirable to investigate the effect of pigment fillers on the cracking and crazing of triallylcyanurate glass-reinforced laminates since the addition of an inert pigment-type filler to a resin results in a decreased resin content in the finished laminate which should result in less shrinkage of the laminate system.

The first variables investigated were the amount of filler necessary to prevent cracking of the resin and the effect of various percentages of filler on the viscosity of the resin. The effect of replacing a part of the resin with

Table IV: Viscosities of various resin-filler mixtures used in preparing test laminates

Filler	Filler %	Viscosity cp.
Vibrin 135		
None	0	2,500
Surfex MM	40	2,500
Kalite	40	6,500
Mica	20	9,100
Asbestos	10	6,500
Wollastonite	40	6,250
Laminac 4232		
None	0	5,000
Surfex MM	40	10,750
Kalite	40	14,250
Mica	20	16,000
Asbestos	10	14,000
Wollastonite	40	10,750
Selectron 5000-468-53		
None	0	7,500
Surfex MM	40	8,500
Kalite	40	33,700
Mica	20	20,000
Asbestos	10	17,000
Wollastonite	40	16,000

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pigment on the heat resistance and strength of the laminate was then studied.

In the preliminary work, carbonate pigments (Surfex MM and Kalite) were ground into uncatalyzed Vibrin 135, Laminac 4232, and Selectron 5000-468-53 resins, using a Morehouse paint mill, in increments of 10%, from 0 to 40% by weight.

Later, other types of fillers, namely Wollastonite, asbestos, and mica, were also investigated. It was believed that the use of these fillers would result in lower values for water absorption. However, the viscosity was found to be greatly increased with lower percentages of these latter fillers.

To observe the influence of fillers on cracking, the pigmented resins were cast in test tubes ⅞ in. in diameter by 6 in. long, cured in a water bath for 4 hr. at 50° F., removed from the test tube and then cured for an additional 3 hr. at 200° F. in a circulating-air oven. The cast resins all required 40% of pigment to prevent cracking. In the case of asbestos, however, only 20% could be used due to the high viscosity. This percentage of asbestos did not prevent cracking.

The two pigments that were found to increase the viscosity of these triallylcyanurate resins the least amount were Surfex MM and Kalite. These two pigments are specially treated calcium carbonate fillers manufactured by

Table V: Ultimate flexural strength and modulus of elasticity of laminates made with 181-301 fabric

Filler	*Room temp. strength (75° F.)*		*High temp. strength (500° F.)*	
	After postcure for 24 hr. at 400° F.	After aging 200 hr. at 500° F.	After postcure for 24 hr. at 400° F.	After aging 200 hr. at 500° F.
No filler	*Vibrin 135 laminates*			
Flexural strength, p.s.i.	52,300	25,000	18,500	17,400
Mod. of elasticity, 10^6 p.s.i.	2.8	2.2	2.1	1.2
40% Surfex MM				
Flexural strength, p.s.i.	52,300	40,900	18,800	21,900
Mod. of elasticity, 10^6 p.s.i.	2.9	2.7	1.9	1.5
40% Kalite				
Flexural strength, p.s.i.	52,500	15,800	13,400	16,100
Mod. of elasticity, 10^6 p.s.i.	3.1	1.6	1.9	1.3
20% mica				
Flexural strength, p.s.i.	43,800	8,400	6,000	7,800
Mod. of elasticity, 10^6 p.s.i.	3.0	1.6	0.7	0.7
10% asbestos				
Flexural strength, p.s.i.	61,700	10,600	10,100	12,500
Mod. of elasticity, 10^6 p.s.i	2.5	1.8	1.3	1.0
40% Wollastonite				
Flexural strength, p.s.i.	49,000	28,200	15,700	20,300
Mod. of elasticity, 10^6 p.s.i.	2.2	1.8	3.5	1.4
No filler	*Laminac 4232 laminates*			
Flexural strength, p.s.i	44,300	21,800	18,700	19,000
Mod. of elasticity, 10^6 p.s.i.	2.0	2.0	1.6	1.3
40% Surfex MM				
Flexural strength, p.s.i.	45,300	29,500	20,200	14,700
Mod. of elasticity, 10^6 p.s.i.	2.7	2.3	1.0	1.4
40% Kalite				
Flexural strength, p.s.i.	42,100	19,800	17,900	19,300
Mod. of elasticity, 10^6 p.s.i.	2.7	2.0	1.8	1.3
20% mica				
Flexural strength, p.s.i.	45,900	15,900	11,400	12,800
Mod. of elasticity, 10^6 p.s.i.	2.1	1.9	1.2	1.1
10% asbestos				
Flexural strength, p.s.i.	51,000	23,100	20,700	21,200
Mod. of elasticity, 10^6 p.s.i.	2.4	2.3	1.6	1.6
40% Wollastonite				
Flexural strength, p.s.i.	41,200	17,500	21,300	17,900
Mod. of elasticity, 10^6 p.s.i.	2.2	1.7	2.1	1.4

Table V continued on facing page

Table V, continued

Filler	Room temp. strength (75° F.) After postcure for 24 hr. at 400° F.	Room temp. strength (75° F.) After aging 200 hr. at 500° F.	High temp. strength (500° F.) After postcure for 24 hr. at 400° F.	High temp. strength (500° F.) After aging 200 hr. at 500° F.
	Selectron 5000-408-53 laminates			
No filler				
Flexural strength, p.s.i.	47,900	28,400	11,200	7,100
Mod. of elasticity, 10^6 p.s.i.	2.9	2.1	1.5	0.7
40% Surfex MM				
Flexural strength, p.s.i.	46,800	18,900	19,400	20,100
Mod. of elasticity, 10^6 p.s.i.	2.7	2.5	2.2	1.4
40% Kalite				
Flexural strength, p.s.i.	55,300	25,800	18,700	17,800
Mod. of elasticity, 10^6 p.s.i.	3.0	2.6	1.8	1.5
20% mica				
Flexural strength, p.s.i.	46,200	21,000	9,500	9,800
Mod. of elasticity, 10^6 p.s.i.	2.8	2.0	1.5	1.2
10% asbestos				
Flexural strength, p.s.i.	51,600	27,200	12,500	14,300
Mod. of elasticity, 10^6 p.s.i.	2.9	2.0	1.5	1.2
40% Wollastonite		8.700	19,100	8,500
Flexural strength, p.s.i.	35,500			
Mod. of elasticity, 10^6 p.s.i.	2.4	1.5	1.5	1.2

Diamond Alkali Company. From Table IV it can be observed that Surfex MM up to 40% by weight has only a minor effect on the increase in viscosity.

In these tests, it was found that the use of 40% Surfex MM and Kalite with the triallylcyanurate resins described above, had the greatest effect on reducing the cracking in the laminates; however, they did not entirely eliminate it.

The flexural strength and modulus of elasticity of the laminates were not significantly reduced by the use of Surfex MM or Kalite fillers when tested at room temperature. The flexural strength of Vibrin 135 and Selectron 5000-468-53 with 40% Surfex MM after heat-aging for 200 hr. and testing at 500° F. was greater than that of the unfilled resin. Changes in flexural strength, modulus of elasticity, water absorption, and loss in weight on exposure to 400 and 500° F. are given in Tables V to VII, inclusive.

Loss of strength due to oxygen

It is well known that the unsaturated alkyd portion of a polyester resin is readily attacked by oxygen. This oxidation probably results in rupture of the alkyd chain and the formation of short chain reaction products which probably accounts for the heat degradation of the laminate and loss of strength.

To check this theory on triallylcyanurate copolymer resins, the samples were aged in an inert atmosphere of nitrogen. An air-tight stainless steel box was obtained having an inlet and outlet tube for the flow of nitrogen. A slotted metal plate was placed in the bottom of the box to hold the ⅛- by 1- by 4-in. laminate specimens in an upright position so that the nitrogen would flow around the specimens.

The box was placed in a circulating-air oven at 500° F. and kept at this temperature for 200 hr. with a constant flow of nitrogen being maintained through the air-tight box. At the end of this period, the laminate specimens were cooled in an atmosphere of nitrogen, then removed and tested for flexural strength and modulus

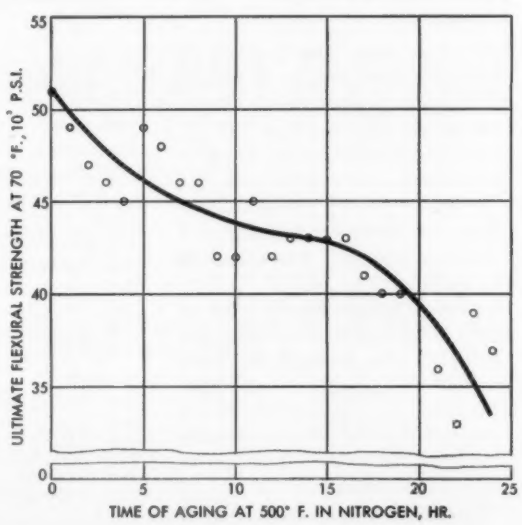

Fig. 2: Effect of aging on flexural strength at 75° F. of typical triallylcyanurate alkyd glass-reinforced laminate

Table VI: Water absorption after 24-hr. immersion

Resin and filler in 181-301 laminate	*Water absorption after 48 hr. aging at 400° F. in air*	*Water absorption after 48 hr. aging at 500° F. in air*
	%	%
	Laminac 4232	
None	3.0	5.1
40% Surfex MM	2.7	4.5
40% Kalite	2.5	3.8
20% mica	3.6	5.1
10% asbestos	4.2	5.1
40% Wollastonite	4.3	5.9
	Vibrin 135	
None	0.7	3.4
40% Surfex MM	1.0	2.2
40% Kalite	2.0	3.1
20% mica	1.0	3.5
10% asbestos	0.4	2.0
40% Wollastonite	1.4	2.2
	Selectron 5000-468-53	
None	2.6	3.8
40% Surfex MM	2.4	3.2
40% Kalite	2.4	3.0
20% mica	2.8	3.4
10% asbestos	2.5	3.5
40% Wollastonite	2.9	3.7

of elasticity at room temperature.

The theory that the loss in strength is due to oxidation seems to be verified by comparing the flexural strength data of laminate samples, heat-aged in air and in nitrogen. Ultimate flexural strengths of the nitrogen-aged samples of both clear and pigmented resins were considerably higher in every case when tested at room temperature and at 500° F. after 200 hr. at 500° F. The data obtained are presented in Table VIII, p. 164.

Postcuring in an inert atmosphere

To determine how the loss in strength progresses in a typical triallylcyanurate copolymer laminate when it is aged at 500° F. in an inert atmosphere, the following test was carried out.

A ⅛- by 22- by 22-in. 181-301 glass cloth laminate impregnated with Laminac 4232 was cured in the press for 3 hr. at 220° F., then put into a circulating-air oven at 500° F. for 3 hr. at which time the laminate was thought to have reached full cure and strength. The panel was removed from the oven and held flat between aluminum caul plates until it cooled to room temperature.

Seventy-five specimens 1 by 4 in. were cut from the panel. Three specimens were saved for flexural tests, and the 72 remaining specimens were put into a stainless steel box in a perpendicular position. The air-tight box was put into an oven at 500° F., and nitrogen flowed through the box during the aging of the specimens. After each hour, for 24 hr., three specimens were removed. The ultimate flexural strength was then determined at room temperature. Figure 2, p. 161, shows how the loss in strength progresses when aged at 500° F. in nitrogen.

Based upon these tests, it can be stated that the optimum physical properties of a typical triallylcyanurate copolymer laminate are obtained after 3 to 4 hr. exposure at 500° F. After further exposure to this temperature in an inert atmosphere, the laminate strength is slowly reduced as shown in Fig. 2. Further checking of aging in an inert atmosphere for periods from 24 to 200 hr., indicates that the curve becomes approximately asymptotic to a line at a flexural strength of 32,000 p.s.i.

Investigation of catalysts

Previous work on triallylcyanurate copolymers has indicated that catalyst systems have considerable influence on ultimate high temperature strength. One catalyst, di-*t*-butyl peroxide was found to give the highest strength.

To investigate the effect that this catalyst had on cracking, as well as on other properties, laminates were prepared from Vibrin 135, Laminac 4232, and Selectron 5000-468-53, catalyzed with 1% of

Table VII: Heat deterioration

Resin and filler in 181-301 laminate	*Loss in weight after aging at 400°F.*		*Loss in weight after aging at 500°F.*	
	24 hr. %	*48 hr.* %	*24 hr.* %	*48 hr.* %
	Laminac 4232			
Clear	1.8	2.5	5.8	7.6
40% Surfex MM	1.4	1.7	4.8	6.4
40% Kalite	2.5	2.6	4.1	5.9
20% mica	1.4	2.6	3.4	5.5
10 asbestos	2.1	3.3	4.0	5.9
40% Wollastonite	1.7	2.8	3.8	6.3
	Vibrin 135			
Clear	0.7	1.0	5.1	6.0
40% Surfex MM	0.7	0.9	2.1	2.7
40% Kalite	1.0	1.2	3.1	3.7
20% mica	0.5	0.8	2.2	3.4
10% asbestos	0.6	0.8	1.9	2.5
40% Wollastonite	0.5	0.8	1.5	2.2
	Selectron 5000-468-53			
Clear	2.7	2.9	4.8	6.6
40% Surfex MM	0.9	1.2	3.1	4.4
40% Kalite	1.2	1.4	3.8	4.7
20% mica	1.0	1.2	3.3	4.6
10% asbestos	1.0	1.4	4.0	5.8
40% Wollastonite	1.8	1.9	3.7	4.6

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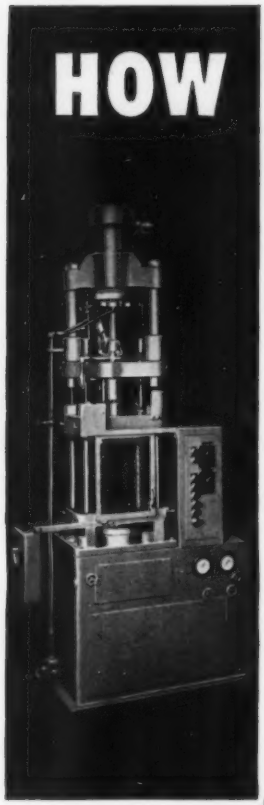
di-*t*-butyl peroxide. In general, a longer initial curing period was required as a result of the use of this high-temperature catalyst. Approximately 3 hr. in the press at 200° F. was required for initial cure. No significant reduction in the cracking of the laminates prepared from these three resins and the catalyst was noted. However, considerable improvement was observed in flexural strengths of the laminate after 200 hr. at 500° F. The tendency of the V-135 laminate to blister also appeared to be eliminated by the use of di-*t*-butyl peroxide. The comparative data on heat deterioration, water absorption, and flexural strengths are given in Table IX, p. 166.

The results of these tests and others previously conducted, indicates that there is probably greater cross-linking of the triallylcyanurate and the alkyd with the use of di-*t*-butyl peroxide, which accounts for the generally higher flexural strengths after exposure to 500° F. for 200 hours. The use of this and other catalyst systems merits further investigation to determine their influence

Table VIII: Ultimate flexural strength and modulus of elasticity of laminates made with 181-301 fabric

	Room-temperature strength (75° F.)			*High-temperature strength (500° F.)*		
	Postcured 24 hr. at 400° F.	*Aged 200 hr. at 500° F.*	*Aged in nitrogen 200 hr. at 500° F.*	*Postcured 24 hr. at 400° F.*	*Aged 200 hr. at 500° F.*	*Aged in nitrogen 200 hr. at 500° F.*
			Vibrin 135 laminates			
No filler						
Flexural strength, p.s.i.	52,300	25,400	34,500	8,500	17,400	29,500
Modulus of elasticity, 10^6 p.s.i.	2.8	2.2	2.4	2.1	1.2	1.9
40% Surfex MM						
Flexural strength, p.s.i.	52,300	40,900	42,500	18,800	21,900	32,300
Modulus of elasticity, 10^6 p.s.i.	2.6	2.7	3.0	1.9	1.5	2.1
40% Kalite						
Flexural strength, p.s.i.	52,500	15,800	41,200	13,400	16,100	31,400
Modulus of elasticity, 10^6 p.s.i.	3.1	1.6	2.6	1.9	1.3	2.2
20% mica						
Flexural strength, p.s.i.	43,700	8,400	25,700	6,000	7,800	16,700
Modulus of elasticity, 10^6 p.s.i.	3.0	1.6	2.4	0.7	0.7	1.4
10% asbestos						
Flexural strength, p.s.i.	61,300	10,600	56,600	10,100	12,500	38,500
Modulus of elasticity, 10^6 p.s.i.	2.5	1.8	2.6	1.3	1.0	2.0
			Laminac 4232 laminates			
No filler						
Flexural strength, p.s.i.	44,300	21,800	29,000	18,700	19,000	30,200
Modulus of elasticity, 10^6 p.s.i.	2.0	2.0	2.6	1.6	1.3	1.6
40% Surfex MM						
Flexural strength, p.s.i.	45,300	29,500	40,300	20,200	14,700	30,700
Modulus of elasticity, 10^6 p.s.i.	2.7	2.3	2.6	1.9	1.4	1.9
40% Kalite						
Flexural strength, p.s.i.	42,100	19,800	34,600	17,900	19,300	30,200
Modulus of elasticity, 10^6 p.s.i.	2.7	2.0	3.0	1.8	1.3	2.1
20% mica						
Flexural strength, p.s.i.	45,900	15,900	39,000	11,400	12,800	36,300
Modulus of elasticity, 10^6 p.s.i.	2.1	1.9	2.5	1.2	1.1	2.0
10% asbestos						
Flexural strength, p.s.i.	51,000	23,100	45,000	20,700	21,200	34,000
Modulus of elasticity, 10^6 p.s.i.	2.4	2.3	2.3	1.6	1.6	1.9
			Selectron 5000-468-53 laminates			
No filler						
Flexural strength, p.s.i.	47,900	28,400	39,900	11,200	7,100	19,900
Modulus of elasticity, 10^6 p.s.i.	2.9	2.1	2.5	1.5	0.7	1.8
40% Surfex MM						
Flexural strength, p.s.i.	46,800	18,900	33,100	19,400	20,100	27,100
Modulus of elasticity, 10^6 p.s.i.	2.7	2.5	3.3	2.2	1.4	2.0
40% Kalite						
Flexural strength, p.s.i.	55,300	25,800	34,100	18,700	17,800	24,900
Modulus of elasticity, 10^6 p.s.i.	3.0	2.6	2.4	1.8	1.5	1.8



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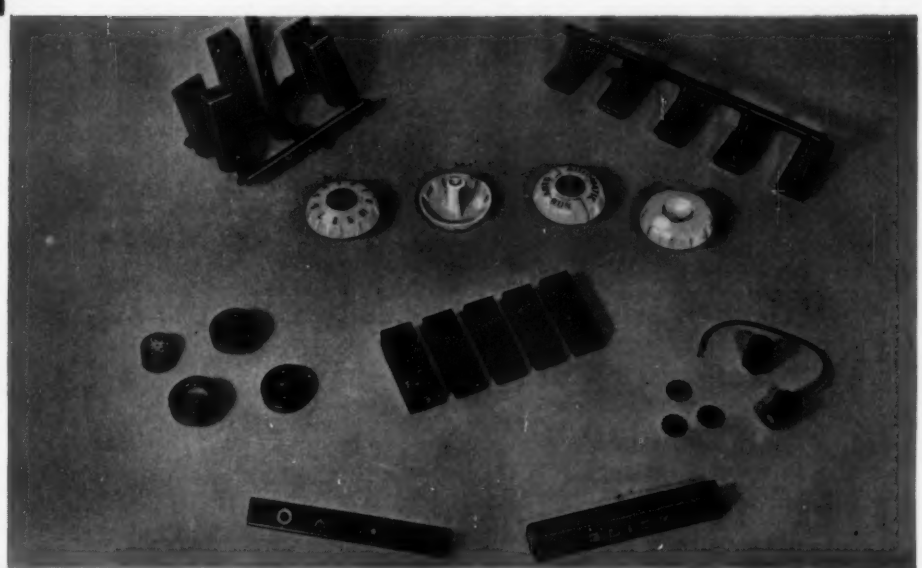

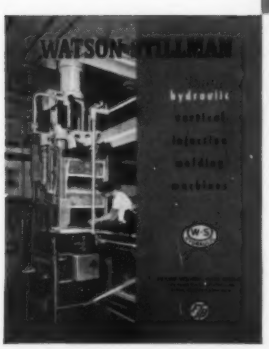

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WRITE FOR THIS GUIDE TO INCREASED PRODUCTION!

Just off the press bulletin tells what is available in the W-S line of vertical injection molding machines. Gives design features, specifications, capacities, dimensions, etc.

WS-16

Table IX: Properties of 181-301 laminates made with resins cured with 1% di-*t*-butyl peroxide

Resin	*After postcure for 3 hr. at 500°F.*	*After aging 200 hr. at 500°F.*	*After postcure for 3 hr. at 500°F.*	*After aging 200 hr. at 500°F.*
Laminac 4232				
Flexural strength, p.s.i.	56,400	25,900	26,600	20,000
Mod. of elasticity, 10^6 p.s.i.	2.8	2.1	1.0	2.5
Vibrin 135				
Flexural strength, p.s.i.	72,400	38,300	26,800	34,000
Mod. of elasticity, 10^6 p.s.i.	3.4	3.0	1.1	2.7
Selectron 5000-468-53				
Flexural strength, p.s.i.	50,700	32,500	27,700	27,900
Mod. of elasticity, 10^6 p.s.i.	2.6	2.3	2.1	1.7

Water absorption after 24-hr. immersion	*After 48 hr. aging at 400°F.*	*After 48 hr. aging at 500°F.*
Laminac 4232, %	5.2	5.8
Vibrin 135, %	3.7	4.3
Selectron 5000-468-53, %	3.4	4.7

Heat deterioration, average weight loss	*Aged at 400°F.*		*Aged at 500°F.*		*Resin*
	24 hr.	*48 hr.*	*24 hr.*	*48 hr.*	*in panel*
Laminac 4232, %	1.4	2.0	1.8	2.8	41.1
Vibrin 135, %	0.4	0.7	1.6	2.1	34.8
Selectron 5000-468-53, %	1.1	1.6	1.2	2.0	38.6

on resistance of the triallylcyanurate copolymer resins to thermal degradation.

Effect of overlay sheets on cracking

Preliminary tests were conducted on the effect of overlay sheets of fibrous glass or asbestos on cracking. It was found that the use of asbestos tended to reduce the cracking of the resin on the surface but the flexural strength after 200 hr. exposure at 500° F. was not satisfactory. However, due to the improved properties obtained in the above tests with Vibrin 135 and di-*t*-butyl peroxide, more laminates were prepared to investigate these two factors.

The laminates were made with Vibrin 135 catalyzed with di-*t*-butyl peroxide. In addition to the usual 12 plies of 181-301 cloth, the laminates were made with overlay sheets of asbestos 9526 obtained from the Raybestos-Manhattan Co. This asbestos sheet, used on each surface, was nominally 0.010 in. in thickness.

These laminates exhibited no signs of cracking even when examined under a 10X microscope. Also, there were no signs of resin degradation on the surface of the laminate after 200 hr. exposure to 500° F. as is normally seen with laminates surfaced with woven glass.

The room temperature and 500° F. flexural strength after exposure to 500° F. for 200 hr., on a comparative basis, was excellent.

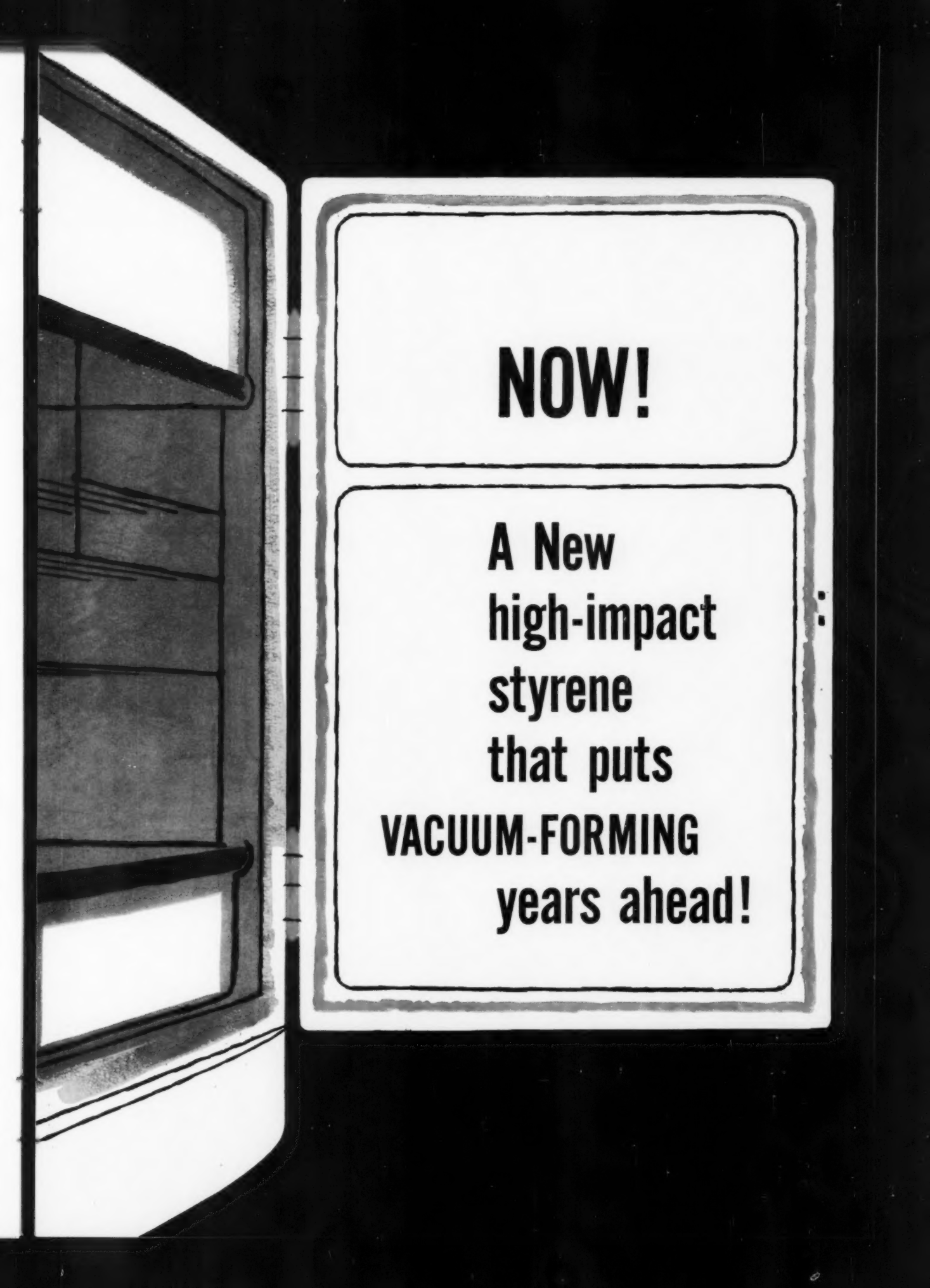
The water absorption after 24-hr. immersion and the heat deterioration were low and very satisfactory. The data obtained are outlined in Table X below.

If there are no unforseen conditions militating against the use of asbestos overlays, this method appears to be a satisfactory solution to the problems of cracking, water absorption, and improvement of the flexural strength after 200 hr. exposure to 500° F.

Table X: Properties of laminates made with Vibrin 135, catalyzed with 1% di-*t*-butyl peroxide, and 181-301 cloth with overlay 9526 asbestos

	Room temperature strength (75°F.)		*High temperature strength (500°F.)*	
	After postcure for 24 hr. at 400°F.	*After aging 200 hr. at 500°F.*	*After postcure for 24 hr. at 400°F.*	*After aging 200 hr. at 500°F.*
Flexural strength, p.s.i.	52,500	36,300	19,600	29,800
Mod. of elasticity, 10^6 p.s.i.	2.5	2.3	1.8	1.8

	Aged at 400°F.		*Aged at 500°F.*		*Resin*
	24 hr.	*48 hr.*	*24 hr.*	*48 hr.*	*in panel, %*
Water absorption after 24-hr. immersion, %	—	2.4	—	3.2	38.2
Heat deterioration, average weight loss, %	1.4	2,1	1.7	2.3	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- **Elongation values of 30 to 40 per cent.**
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- **Improved extrudability, giving increased production rates.**
- **Better gloss and surface grain.**
- **No contamination by dust or foreign particles.**

Bakelite Company announces the development of an entirely new styrene compound for sheet extrusion and vacuum forming.

FOR LARGE SECTIONS

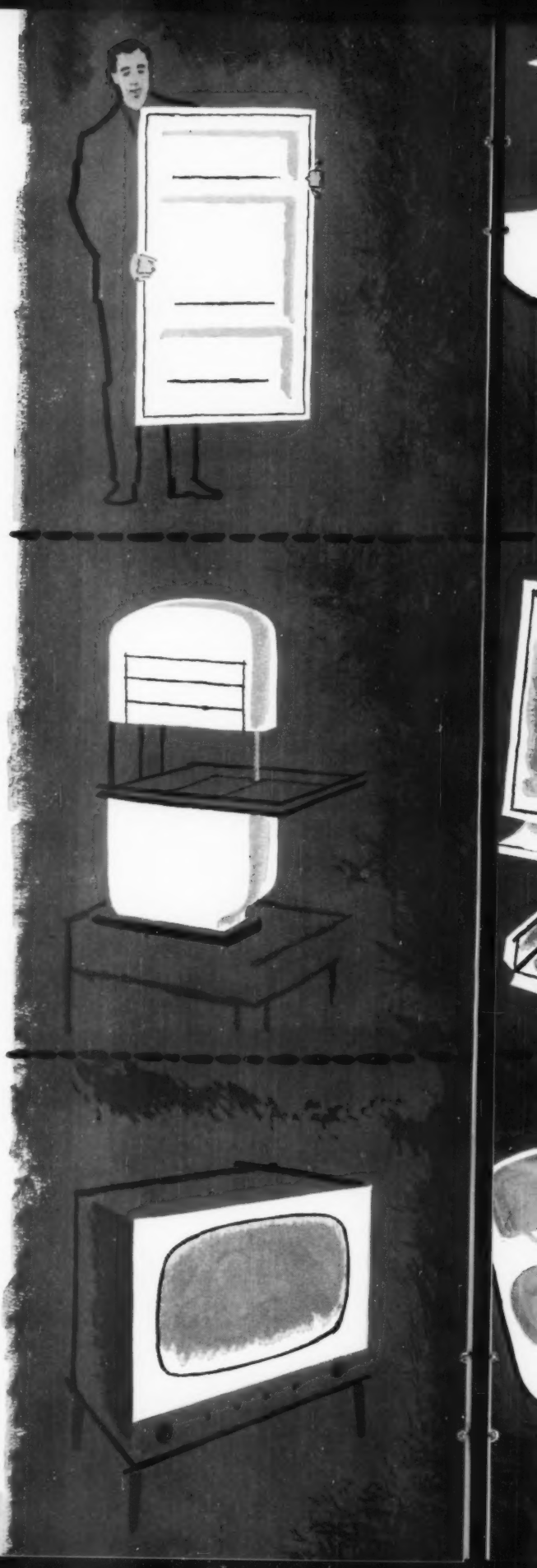
TGD-6000 is a rubber-modified high-impact material with a number of improvements unmatched by other compounds now available. It is particularly suitable for such large-sized sections as refrigerator door liners, from the standpoint of both production and performance.

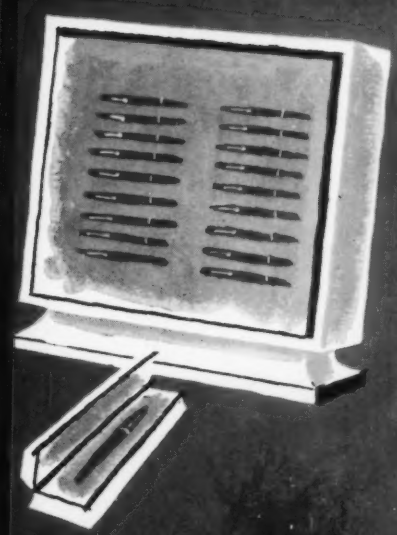
GREATER ELONGATION

For example, it has an elongation of more than 30 per cent in extruded sheet, permitting sufficient expansion and contraction of vacuum-formed sheets under varying conditions. This feature provides a great reduction in refrigerator door liner cracks around metal fixtures.

HIGHER IMPACT STRENGTH

The high rigidity of TGD-6000 permits thinner door liners and lessens or eliminates need for reinforcements. Even at sub-normal temperatures, this BAKELITE Brand Styrene has excellent resistance to shock fracture. Its impact strength is 25 per cent greater than that of other leading impact styrenes.





BETTER APPEARANCE

The high heat stability of BAKELITE Impact Styrene TGD-6000 results in an improved surface appearance. Uniform colors and absence of streaking are also evident. Color stability is excellent even under heat polishing.

PRODUCTION ECONOMY

The enclosed system of manufacturing this material eliminates contamination by foreign particles. In extrudability, TGD-6000 is superior to any other material of its type. It results in fast extrusions of uniformly high quality on conventional equipment. In vacuum-forming, TGD-6000 demonstrates its excellent strength and elongation. Highly detailed designs and deep draws are formed without cracking, breaking, or warping at the corners.

APPLICATIONS

In addition to refrigerator door liners, other articles suggest themselves for vacuum-forming from extruded sheets of TGD-6000:

DISPLAYS • SIGNS • TOYS • HOUSEWARES • TELEVISION MASKS • HOUSINGS AND GUARDS • NOVELTIES

For details on this new BAKELITE Impact Styrene, write Dept. XX-00 and ask for the TGD-6000 booklet.

TABLE OF PROPERTIES

Tensile Strength, psi	3400
Elongation, %	30
Izod Impact Strength, ft.lb./in. @ 23° C	1.0
@ 0° C	0.85
Modulus of Elasticity in Flexure, psi x 10^5	3.6
Flexural Strength, psi	8000
Hardness, Durometer D	80

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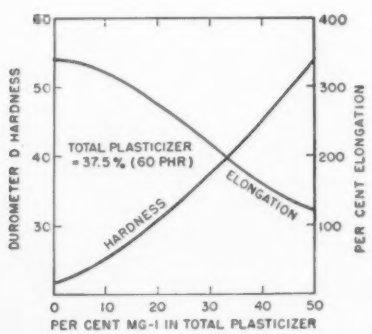
- *toys and balls*
- *wire and rack coatings*
- *tank linings*
- *foams and sponges*
- *gaskets*
- *and other products that require hard vinyl plastics made by plastisol techniques.*

Here's why! Monomer MG-1 is a high-boiling, low viscosity dispersant for polyvinyl chloride resins. Fluid plastisols are prepared with MG-1 in combination with conventional plasticizers. MG-1 polymerizes during the normal plastisol fusion cycle to produce hard plastics. The concentration of MG-1 controls the flexibility or rigidity of the finished product. This graph shows the effect of MG-1 on plastisol films.



Plastisol fabricated vinyls made with Monomer MG-1 also have these outstanding properties:

- *improved oil extraction resistance*
- *reduced "rub-off"*
- *improved electrical properties*
- *reduced volatile loss*
- *increased gloss*
- *improved scuff resistance*

U. S. Patent 2,618,621 covers the use of Monomer MG-1 in vinyl chloride dispersions. This patent is now being licensed by UNION CARBIDE.

If plastisol fabrication is your business, Monomer MG-1 may open new markets for you. Write for technical data, samples, and licensing information. Address Union Carbide Chemicals Company, Department B, 30 East 42nd Street, New York 17, New York. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto.

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Effects of rates of straining on some tensile properties of polyester film

By Charles F. Bersch, Frank L. McCrackin,* and Karl F. Plitt**

A recently developed method for gathering high-velocity longitudinal impact data was evaluated for use on plastic films. The energy to rupture and the maximum strain at rates of straining of 400,000 to 800,000% per min. were determined on 3-mil polyester film and related to similar data gathered at rates of straining prevailing in static tensile tests. Easier and more precise methods of calculation are offered for determining the initial velocity of the head mass after impact and of the energy to rupture. Limitations of the methods, areas needing further development, and suggestions for further study are indicated.

The ever increasing uses of plastics in applications where they are subjected to impact and to high accelerations have resulted in a need for more knowledge of the behavior of plastics under these conditions. Plastic items that encounter impact include safety helmets, body armor, shuttles, and disposable plastic parachutes.

The purpose of this investigation was, first, to adapt equipment designed for studying textile yarns at rates of straining as high as 800,000% per min. for use with plastics. A second purpose was to investigate the behavior of oriented polyester film (Mylar, E. I. du Pont de Nemours and Co., Inc.) under conditions of very rapid loading, and to show, if possible, the effect of direction of orientation on behavior under these conditions.

Equipment and method

The high-velocity longitudinal impact equipment developed by Stone, Schiefer, and Fox (1)[1] was used to measure the high-velocity longitudinal impact behavior of polyester film at rates of straining of 400,000 to 800,000% per minute. A strip of film about 65 cm. long and 3 mm. wide was fastened to head and tail masses as shown in Fig. 1, below, and then inserted in a clear plastic tube. A 5-hp. variable-speed motor was used to drive a flywheel fitted with a set of hammers which passed on either side of the specimen head mass. When the flywheel reached the desired velocity the specimen tube and specimen were rotated so the head mass was impacted by the hammers at a velocity of from 40 to 80 m./sec. and the specimen and two masses moved in free flight. Their motion was photographed against a background containing a centimeter scale by a high speed camera operating at about 7,000 frames per second. Mirrors were arranged so that images of both

[1] Numbers in parentheses link to references at end of article, p. 178.

*Plastics Section, National Bureau of Standards. This work was sponsored by the Office of the Quartermaster General, Research and Development Laboratories, Natick, Mass.

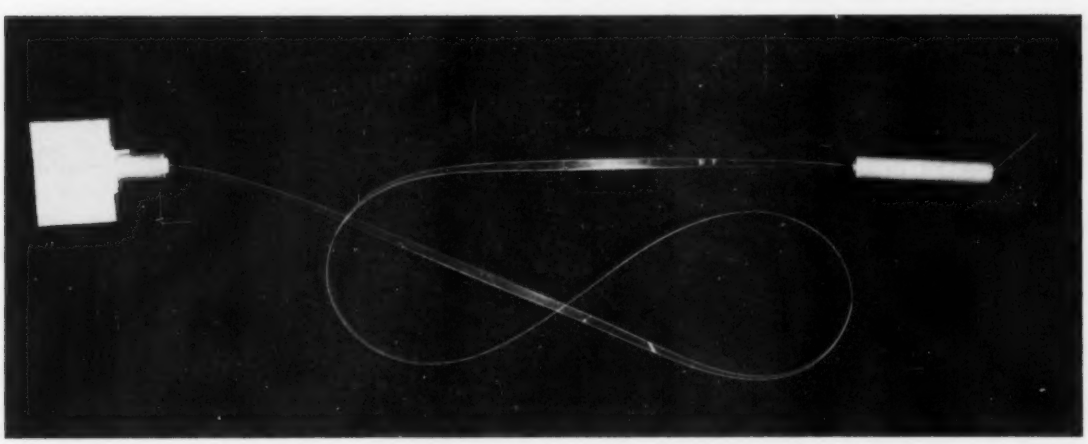

Fig. 1: Strip of polyester film, 3 mm. wide and 65 cm. long, fastened to head and tail masses

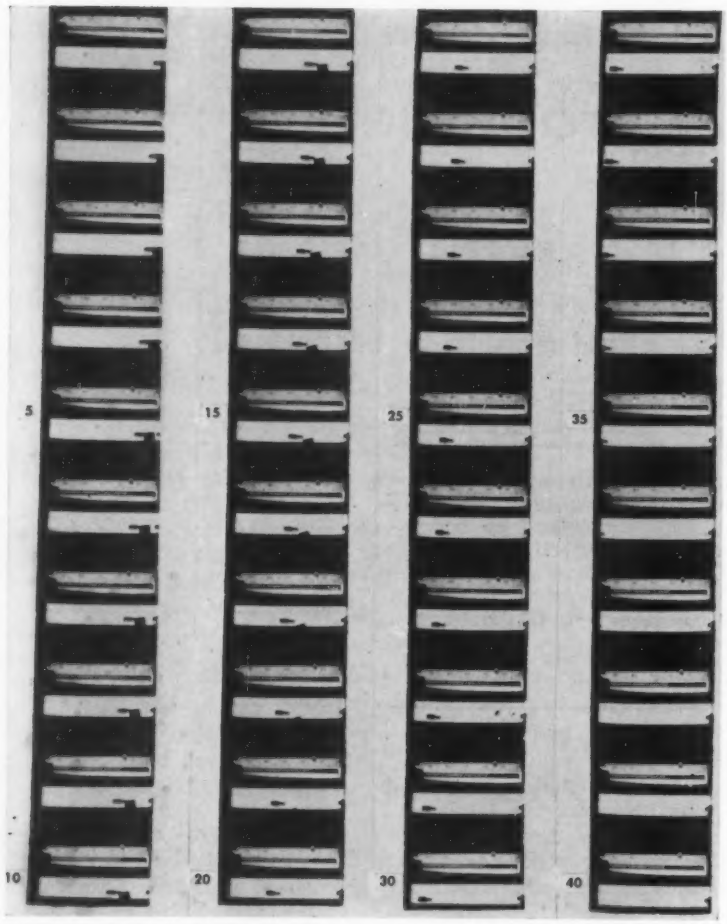

Fig. 2: Photographic record of high-velocity longitudinal impact test of polyester film. The full record of the flight of the head mass may be followed in the pictures in the lower half of each frame. The first stages of the flight of the tail mass are shown in the pictures in the upper half of each frame. Rupture of the specimen occurred at frame 55 (only 40 frames shown above)

the head and tail were recorded on each frame of the film, as may be seen in Fig. 2, above. The positions occupied by the head and tail masses were measured from each frame.

Specimens of the plastic film, with the same width and prepared in the same way, were tested on a tensile testing machine at rates of straining of 1, 10, and 100% per minute. Method A of A.S.T.M. Tentative Method of Test D 882-54T was followed, except for specimen dimensions.

Material tested

Oriented polyester film of 3-mil nominal thickness was tested. The weight per unit area of the film was 0.0105 g./sq. cm. The thickness of the film varied about 9%, the variation of the width of the specimens was held to less than 4%, and the weight per unit area varied less than 10 percent.

Specimens cut parallel to the longest dimension of the film were designated as lengthwise and specimens cut parallel to the roll were designated as crosswise.

Polyester film specimens of uniform width were cut from the film sheet by taping a piece of film to a thin sheet of aluminum and then cutting the aluminum in a metal-shearing machine. Strips 3 mm. wide were cut and measured, and only those that varied less than 4% in width were used. Visual examination of the edges of the specimens revealed no flaws that might lead to stress concentrations during the tests.

The manner of attachment of the specimen is important, since the specimen must not be damaged in any way, but must be held firmly and evenly so that stress concentrations and slippage do not occur. For the high-velocity longitudinal impact tests the specimens were held in the head and tail masses by hardwood wedges coated with rubber cement. For the tensile tests the specimens were placed between pieces of masking tape before being clamped in the grips.

All specimens were conditioned for at least 1 week at 23° C. and 50% relative humidity prior to testing.

Theoretical analysis

The theoretical analysis of the high-velocity longitudinal impact method has been given by McCrackin *et al.* (2) and Smith *et al.* (3, 4). For this investigation the analysis was modified to give an expression for the energy required to rupture the specimen in terms of the initial velocity, V_0, of the head mass after impact and the final velocity, V_{Tf}, of the tail mass after the specimen has ruptured.

While the impact velocity of the head mass may be determined from the initial slope of the curve of head position versus time as in Fig. 3, p. 174, it may be determined more accurately using conservation of momentum.

The momentum of the specimen, head mass, and tail mass just after the head mass is impacted is given by the effective head mass, $M + w/2$, times the initial velocity, V_0, of the head mass. The momentum of the system at a later time is given by the sum of the effective head mass, $M + w/2$, times the head velocity, V_H, and the effective tail mass, $N + w/2$, times the tail velocity, V_T. Therefore, by conservation of momentum,

$$(M + w/2)\,V_0 = (M + w/2)\,V_H + (N + w/2)\,V_T \quad \text{Eq. 1}$$

The effective head and tail masses are obtained by adding half the mass, w, of the specimen to the actual head mass, M, and tail mass, N; this has been shown by Smith *et al.* (3) to give results very close to those of a derivation

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taking the wave motion of the specimen into account.

Multiplying both sides of equation 1 by dt and integrating with respect to time gives

$$(M + w/2)\, V_0\, t + C = (M+w/2)\, X_H + (N+w/2)\, X_T \quad \text{Eq. 2}$$

where X_H and X_T are the positions of the head and tail masses at time t and C is the constant of integration, which is arbitrary, depending on the position of the scale used to measure X_H and X_T. The value of C is not important in the following derivation.

To evaluate V_0,

$$X_H + \left[\frac{N + w/2}{M + w/2}\right] X_T$$

is plotted against time, as in Fig. 3, to give a straight line. Then, by Eq. 2, V_0 is given as the slope of this line.

The energy used to rupture the specimen is given by the initial kinetic energy of the system minus the remaining kinetic energy after the specimen ruptures. Just after impact only the head mass is in motion, so the initial kinetic energy of the system is ½ (M + w/2) V_0^2. At rupture of the specimen the remaining kinetic energy of the head mass is ½ (M + w/2) V^2_{Hf}, and the kinetic energy of the tail mass is ½ (N + w/2) V^2_{Tf}, where V_{Hf} and V_{Tf} are the velocities of the head and tail masses at rupture. Therefore, the energy used to rupture the specimen is

$$E = 1/2\,(M+w/2)\,(V_0^2 - V_{Hf}^2) - 1/2\,(N+w/2)\,V_{Tf}^2 \quad \text{Eq. 3}$$

However, Eq. 3 is unsatisfactory

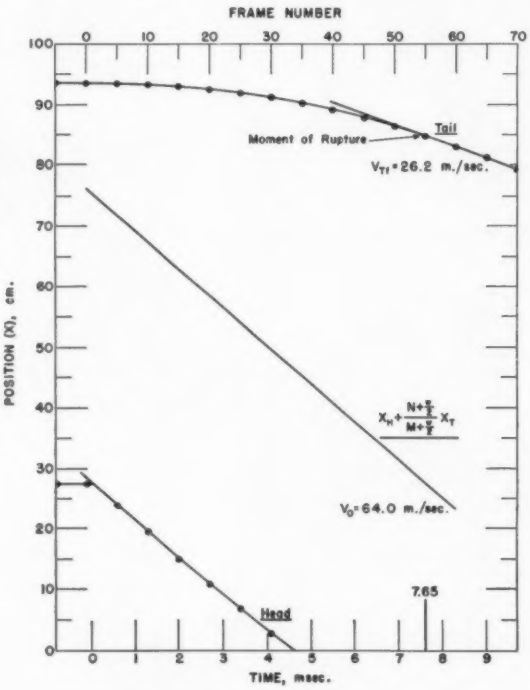


Fig. 3: Distance-time curves for a typical high-velocity longitudinal impact test and graph of

$$X_H + \left[\frac{N + w/2}{M + w/2}\right] X_T$$

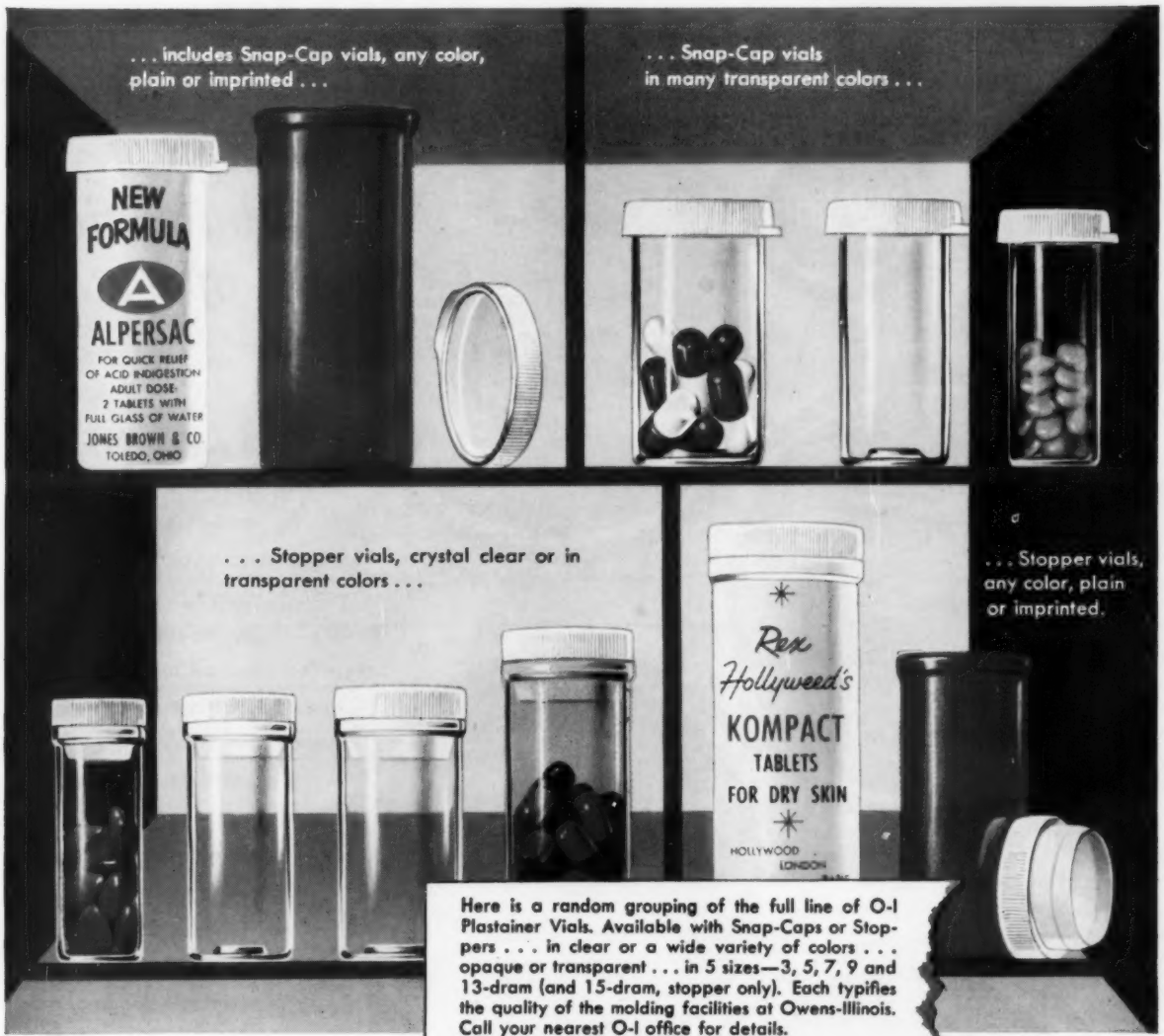
versus t for determination of V_0. Rupture occurred 7.65 millisec. after impact

Table I: Tensile properties of 3-mil polyester film

Rate of strain, %/min.	*Energy to rupture* 1	10	100	*Maximum strain* 1	10	100	*Residual strain* 1	10	100	*Recovered strain* 1	10	100
	j./g.[a]	*j./g.*[a]	*j./g.*[a]	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Lengthwise[b]												
Specimen 1	73.0	45.3	58.0	82.9	56.0	66.4	—	40	49	—	16.0	15.6
2	61.2	69.7	95.4	71.3	79.1	98.4	57	61	78	14.3	18.1	20.4
3	75.2	102.1	73.6	88.3	107.3	80.6	70	87	61	18.3	20.3	19.6
4	64.0	96.0	64.7	75.0	103.6	73.1	57	84	55	18.0	19.6	18.1
5	—	55.5	53.9	—	67.0	62.7	—	50	45	—	17.0	17.7
Average and	68.4	73.7	69.1	79.4	82.6	76.2	61.3	64.4	57.6	16.9	18.2	18.3
standard error	±3.4	±11.1	±7.4	±3.8	±10.0	±6.3	±2.5	±4.1	±2.6	±0.7	±0.4	±0.4
Standard deviation	6.80	24.8	16.5	7.67	22.4	14.1	7.5	20.7	12.9	2.23	1.78	1.86
Crosswise[b]												
Specimen 1	—	65.4	80.6	—	67.0	80.8	—	50	64	—	17.0	18.8
2	—	35.2	70.4	—	42.8	69.0	—	30	53	—	12.8	16.0
3	—	84.3	107.1	—	84.0	100.6	—	69	82	—	15.0	18.6
4	—	82.8	74.6	—	84.7	79.2	—	69	63	—	15.7	16.2
5	—	65.1	97.3	—	68.3	98.4	—	52	—	—	16.3	—
Average and		66.6	86.0		69.4	85.6		54.0	65.5		15.4	16.9
standard error		±8.8	±7.0		±7.6	±6.0		±3.2	±3.0		±0.3	±0.3
Standard deviation		19.8	15.6		17.0	13.5		16.2	12.1		1.61	1.18

[a] Joules/gram
[b] Specimens cut parallel to the longest dimension of the film were designated as lengthwise and specimens cut parallel to the roll were designated as crosswise.

NEW FULL LINE of Plastainer Vials by Owens-Illinois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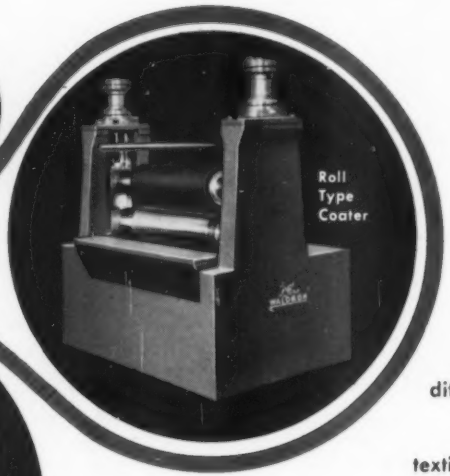

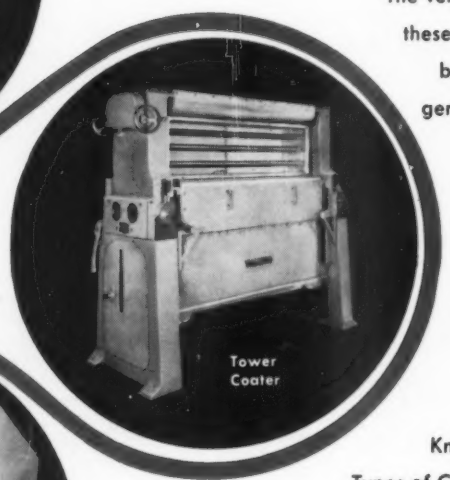

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Table II: High-velocity longitudinal impact data for 3-mil polyester film cut lengthwise

V_0[a]	*Energy to rupture*	*Rupture strain*	*Residual strain*	*Recovered strain*
m./sec.	*j./g.*[b]	*%*	*%*	*%*
56.6	8.1	11.3	—	—
57.7	3.9	—	—	—
61.4	10.2	12.0	—	—
59.7	44.1	49.4	—	—
64.3	42.5	42.4	24.2	18.2
65.0	48.3	45.0	—	—
69.3	65.3	66.8	45.2	21.6
72.5	62.4	59.6	—	—
79.5	56.1	54.5	35.5	19.0
Average and standard error of 6 values	53.1±3.92	53.0±3.78	35.0±3.50[c]	19.6±1.05[c]
Standard deviation	9.60	9.23	10.50	3.16
Average of all values	37.9	42.6		
Standard deviation	24.1			
Median of all values	44.1	47.2		

[a] Initial velocity of head mass, immediately after impact, in meters per second
[b] Joules/gram
[c] Average of three values

Table III: High-velocity longitudinal impact data for 3-mil polyester film cut crosswise

V_0[a]	*Energy to rupture*	*Rupture strain*	*Residual strain*	*Recovered strain*
m./sec.	*j./g.*[b]	*%*	*%*	*%*
48.1	30.2	28.6	—	—
60.4	16.6	15.2	—	—
72.0	2.1	—	—	—
59.3	56.5	53.9	33.9	20.0
64.0	60.4	57.3	38.7	18.6
64.4	49.5	45.5	27.4	18.1
65.9	40.3	35.3	19.3	16.0
68.1	68.7	62.4	43.5	18.9
68.4	57.2	52.1	33.9	18.2
74.3	67.0	59.8	43.5	16.3
Average and standard error of 7 values	57.1±3.72	52.3±3.52	34.3±1.25	18.0±0.20
Standard deviation	9.86	9.32	8.77	1.42
Average of all values	44.9	45.6		
Standard deviation	22.0			
Median of all values	53.0	52.1		

[a] Initial velocity of head mass, immediately after impact, in meters per second
[b] Joules/gram

for calculating the energy to rupture because V_0 and V_{Hf} were found to differ so slightly that the calculated value of E was inaccurate. This difficulty, and the necessity for measuring V_{Hf}, are removed by eliminating V_{Hf} from Eq. 3. At the time of rupture Eq. 1 gives

$$(M+w/2)\,V_0 = (M+w/2)\,V_{nf} + (N+w/2)\,V_{Tf} \quad \text{Eq. 4}$$

Substituting for V_{Hf} in Eq. 3 from Eq. 4 gives

$$E = (N+w/2)\,V_{Tf}\left[V_0 - \frac{M+N+w}{2M+w}\,V_{Tf}\right] \quad \text{Eq. 5}$$

After rupture the velocity of the tail mass remains constant except for air friction, which is negligible (2). Therefore, by Eq. 5 the tail mass velocity after the specimen ruptures, the initial head mass velocity, and the masses of the specimen, head, and tail can be used to determine the rupture energy of the specimen.

Results and calculations

Tensile tests of the 3-mil oriented polyester film were made at crosshead separation rates of 0.1, 1, and 10 in./min. The initial rates of straining were 1, 10, and 100% per minute for specimens 10 in. long. The energy to rupture was measured by an integrator connected to the testing machine. Elongation at rupture was read from the chart recorder and residual strain was measured after the specimen was removed from the grips, within 2 min. after the end of the test. The recovered strain is the difference between the maximum and residual strains. These data are presented in Table I, p. 174.

Fig. 3 presents the distance-time curve for a typical high velocity longitudinal impact experiment. The energy to rupture was calculated using Eq. 5. The initial velocity of the head was found from the slope of the curve of

$$X_n + \left[\frac{N+w/2}{M+w/2}\right] X_T \text{ versus } t$$

using equation 2. V_{Tf} was obtained from the slope of the straight-line portion of the tail mass curve. The moment of rupture is indicated by the beginning

Table IV: Summary of data in Tables I, II, and III, excluding the first group of data in Tables II and III

Property measured	Rate of strain %/min.	Specimen orientation: Lengthwise j./g.[a]	Lengthwise ft.-lb. / lb.	Crosswise j./g.[a]	Crosswise ft.-lb. / lb.
Energy to rupture					
	1	68.4±3.4[b]	22,900	—	—
	10	73.7±11.1	24,600	66.6±8.8	22,300
	100	69.1±7.4	23,100	86.0±7.0	28,800
	4-8×10⁵	53.1±3.9	17,800	57.1±3.7	19,100
Rupture strain		%		%	
	1	79.4±3.8		—	
	10	82.6±10.0		69.4±7.6	
	100	76.2±6.3		85.6±6.0	
	4-8×10⁵	53.0±3.8		52.3±3.5	
Residual strain		%		%	
	1	61.3±2.5		—	
	10	64.4±4.1		54.0±3.2	
	100	57.6±2.6		65.5±3.0	
	4-8×10⁵	35.0±3.5		34.3±1.3	
Recovered strain		%		%	
	1	16.9±0.7		—	
	10	18.2±0.4		15.4±0.3	
	100	18.3±0.4		16.9±0.3	
	4-8×10⁵	19.6±1.1		18.0±0.2	

[a] Joules/gram
[b] Standard error

of the straight-line portion of the tail mass curve and occurred about 7.65 milliseconds after impact. The maximum strain or strain at rupture was calculated from the difference between the head and tail positions at the moment of rupture. As the head mass passed out of camera range before rupture occurred, the head mass position at the moment of rupture was determined from an extension of the curve

$$X_H + \left[\frac{N + w/2}{M + w/2}\right] X_T.$$

Tables II and III, p. 177 list the high-velocity longitudinal impact data at rates of straining of 400,000 to 800,000% per minute. While the first three values listed in Tables II and III are similar to the values found in tests on specimens with flaws or in tests that had mounting failures, no evidence of specimen flaws or improper mounting were observed with these particular specimens. Table IV, above, is a summary of the information in Tables I, II, and III.

The tensile data listed in Table I had a large amount of variability, only a part of which was accounted for by the variability of the cross-sectional area of the specimens. The remainder is attributed to minute flaws occurring in manufacture and minute flaws due to handling. The high velocity longitudinal impact data exhibit a much greater variability than the tensile data if the first three values in Tables II and III are included. These low values could not be excluded because no physical reason for excluding them was observed. Neither could they be dropped on probability considerations because of their frequency of occurrence and because the distribution to be expected of the data is unknown. They are not included in the summary of results presented in Table IV because they are not considered characteristic of the material. They may have been due to damage of the film in handling or due to the large effect a flaw would have on the narrow specimens tested.

Summary and conclusions

The energy to rupture, the strain at rupture, and the residual strain of polyester film were found to be roughly 25% less at rates of straining of 400,000 to 800,000% per minute than at rates of straining of 1 to 100% per minute. The recovered strain, which is an approximation of the elasticity of the material, was relatively constant for all rates.

No significant difference was found, at either low or high rates of straining, between the rupture energies of specimens cut in the lengthwise or crosswise direction of the polyester sheet. Therefore, any difference in rupture energy due to a difference in orientation of the film in the two directions is less than the variability found between specimens cut in the same direction.

The method described for obtaining high velocity longitudinal impact data from plastic films has been found useful as a means of gathering data to enable one to predict the behavior of a material at very high rates of straining. As such the method has considerable value as a tool for engineering research.

The method is of potential interest as a tool for fundamental research in the study of the relation of molecular structure and physical behavior. It can be used to relate energy to rupture or strain at rupture to rate of straining and it can be used to gather data to be used in clarifying the effects of temperature and rate of strain on the physical properties.

The authors wish to express their appreciation to Walter K. Stone for performing the high-velocity longitudinal impact tests and to Lee A. Dunlap for his assistance in preparing specimens and film records of the tests.

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Effect of gamma radiation on epoxy plastics

By E. L. Colichman and J. D. Strong**

The extent to which typical thermally cured epoxy plastics might be improved by radiation postcuring has been investigated. Nine different epoxy compositions were studied containing various curing agents and the presence or absence of reactive diluents. Gamma radiation dosages were 10^6, 10^7, and 10^8 roentgens. Physical properties measured on irradiated and unirradiated specimens were hardness, heat distortion temperatures, and compressive strengths. Hardness properties were found to change the greatest amount. Hardness results can be correlated with the molecular structure of the epoxy compositions and can be used as a measure of radiation resistance. Epoxy plastics are highly radiation resistant and little change occurs in hardness on radiation when relatively inert aromatic-type curing agents are used. Active methylene groups permit cross-linking analogous to that occurring in polyethylene, and hardness increases in excess of 50% were obtained in these epoxy compositions at gamma dosages of 10^8 roentgens. If reactive groups are present that allow radiation-promoted vinyl polymerization to occur, the concentration of these reactive diluents determines whether hardness increases or decreases as a result of radiation.

Heat distortion temperatures and compressive properties are little changed by radiation up to at least 10^8 roentgens. Specific epoxy compositions show increases in compression strength of about 7 percent.

Radiation curing of epoxy resins to form rigid plastics without using heat is possible with compositions that permit vinyl polymerization. Radiation curing alone apparently results in a smaller and less desirable polymer molecule, due probably to the fact that the curing agents cause polymerization normally by condensation reactions which are not radiation promoted.

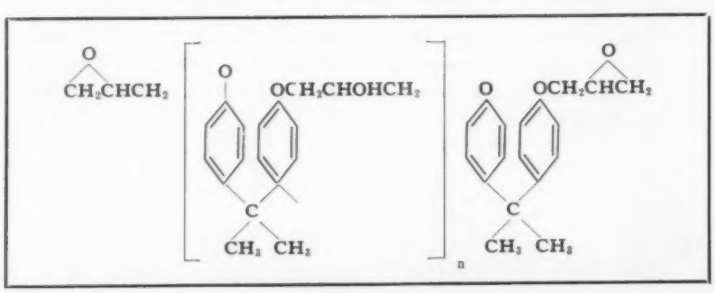
Commercial epoxide resins are the product of epichlorohydrin and polyhydroxy compounds. Almost all of these resins, currently available, are made using bisphenol-A as the polyhydroxy compound. An excess of epichlorohydrin is used commercially so that end groups of the resin are epoxy groups (see Formula 1) and varying properties are obtained by achieving different n values experimentally. Values of n are usually 0 to 7. These resins are available from the manufacturers as viscous sirups in which the average n is between zero and unity. Active hydrogen compounds such as polyamines, polybasic acids, polyhydric phenols, and polyamides are used as curing agents to bring about condensation polymerization with the terminal epoxy groups, thereby yielding high-molecular-weight polymers that are rigid plastic compositions. These plastics generally exhibit glass-like hardness, extreme toughness, unusual adhesive characteristics towards most surfaces, and inertness. The desirable physical properties are probably due to the high degree of polymerization of the epoxide group and the symmetry and rigidity of the dihydric phenolic unit causing insolubility and nonsaponification without sacrificing polarity.

Epoxide resins are being used commercially as surface coatings, insulating materials, and adhesives as well as for casting, impregnating, and potting electronic components. In view of the growing importance of this field, an investigation was undertaken to learn if gamma radiation could be used effectively to improve the physical properties of epoxy plastic compositions.

Epoxy plastics prepared

A viscous oil, ERL-2774 (Bakelite Co.), made from epichlorohydrin and bisphenol-A, was used in making all the formulated epoxy plastics. Epoxy equivalent weight is 192.5 g. indicating that the n value in Formula 1 is essentially zero.

Formulations involved variations in the curing agents (amines and pyromellitic dianhydride) as well as absence or presence of reactive diluents (styrene oxide and allyl glycidyl ether). Curing agents were added in quantities equal to "epoxy equivalent" of ERL-2774, plus a few percent excess. Allowance also was made for quantity of reactive diluent



FORMULA 1

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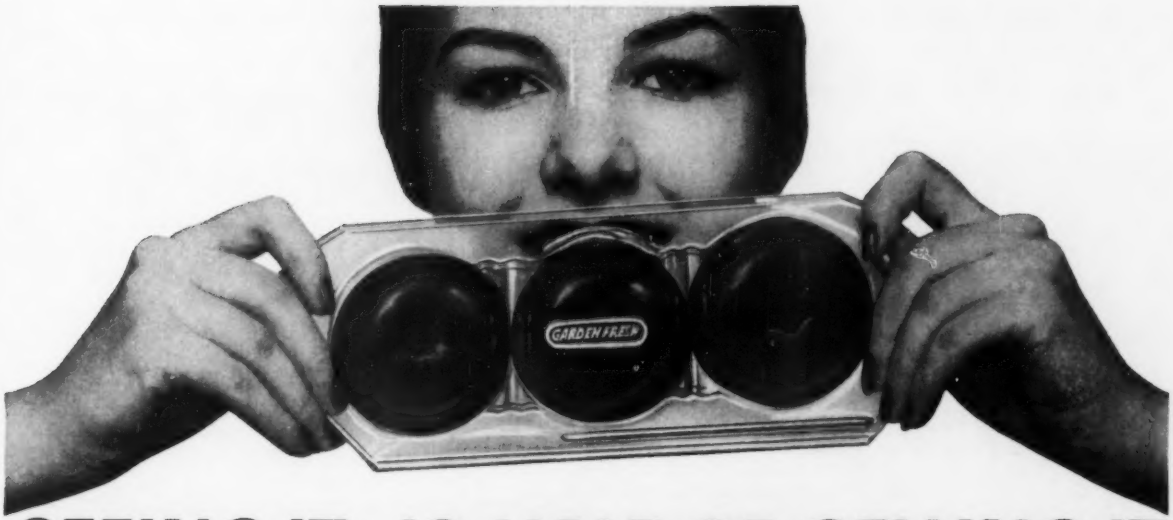

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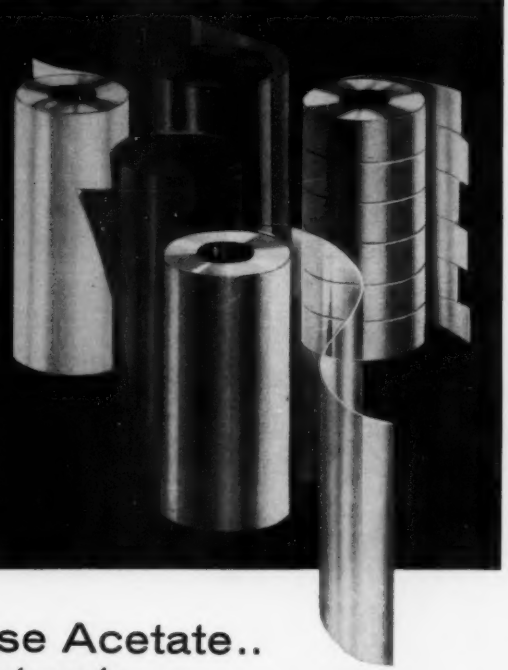

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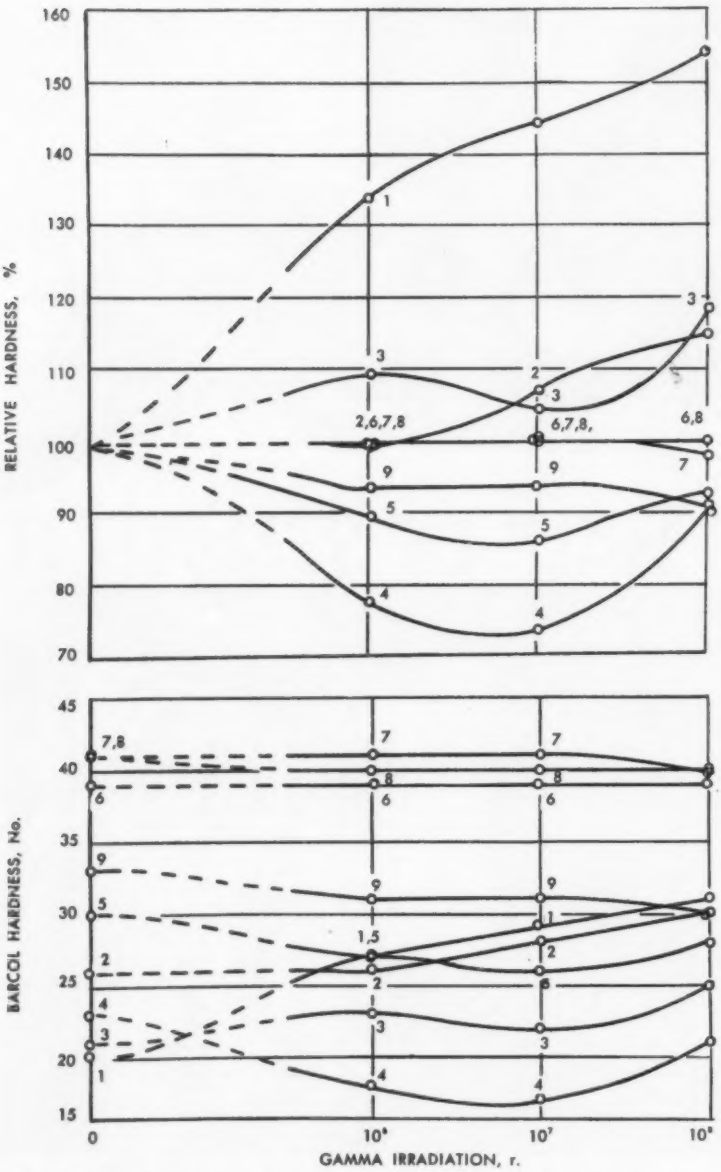

Fig. 1: Hardness versus irradiation for epoxy plastics. Numerals refer to formulations as follows: 1—typical standard formulation, amine-cured; 2—standard formulation with aromatic reactive diluent; 3—standard formulation with aliphatic reactive diluent; 4—standard formulation with high concentration of aliphatic reactive diluent; 5—standard formulation with high concentration of aromatic reactive diluent; 6—typical formulation, aromatic dibasic acid-cured; 7—typical formulation, aromatic dibasic acid-cured, with aliphatic reactive diluent; 8—typical formulation, aromatic dibasic acid-cured, with aromatic diluent; 9—another formulation, aromatic amine-cured

present. Several preliminary trial epoxy plastics preparations, not reported here, were attempted. Finally, nine epoxy plastic formulas were decided upon as representative for the radiation effects study.

These formulations were prepared as follows:

1) Typical standard formulation, amine cured: 200 g. of ERL-2774; 53.0 g. of p,p′-methylenedianiline. Resin was heated to 90° C., p,p′-methylenedianiline to 100° C., then combined, mixed well, and poured into glass tubes. The mixture was then cured for a period of 4½ hr. in an oven maintained at a temperature of 165 ± 10° C.

2) Standard formulation with aromatic reactive diluent: 200 g. of ERL-2774; 24.0 g. of styrene oxide; 63.2 g. of p,p′-methylenedianiline. The p,p′-methylenedianiline was heated to 110° C., the resin with styrene oxide added heated to 50° C., then mixed well, and the mixture then set aside overnight at room temperature. Samples were then heated for a period of 2 hr. at 85° C. and then at 165 ± 10° C. for a period of 4½ hours.

3) Standard formulation with aliphatic reactive diluent: 200 g. of ERL-2774; 19.6 g. of allyl glycidyl ether; 63.2 g. of p,p′-methylenedianiline. The resin and allyl-glycidyl ether were heated to 60° C. and the p,p′-methylenedianiline was heated to 120° C., then combined and the mixture set aside at room temperature overnight. The mixture was then heated at 85° C. for a period of 2 hr., then at 165 ± 10° C. for 4½ hr. to complete cure.

4) Standard formulation with high concentration aliphatic reactive diluent: 200 g. ERL-2774; 49.0 g. allyl glycidyl ether; 78.6 g. of p,p′-methylenedianiline. The resin and allyl glycidyl ether were heated to 65° C. and the p,p′-methylenedianiline, heated to 110° C., was added. After standing at room temperature overnight, mixture was heated to 85° C. for a period of 2 hr., then to 165 ± 10° C. for 4½ hours.

5) Standard formulation with high concentration aromatic reactive diluent; 200 g. of ERL-2774; 60.0 g. of styrene oxide; 78.6 g. of p,p′-methylenedianiline. The resin and styrene oxide were heated to 65° C. and the p,p′-methylenedianiline to 100° C. before mixing. After standing at room temperature overnight, the mixture was then heated to 85° C. for a period of 2 hr., then to 165 ± 10° C. for a period of 4½ hours.

6) Typical formulation, aromatic dibasic acid cured: 200 g. of ERL-2774; 58.4 g. of pyromellitic dianhydride; 0.05 g. of p,p′-methylenedianiline. The resin was heated to 60° C. and then poured into a Waring blender before adding the curing agents. Mixing was

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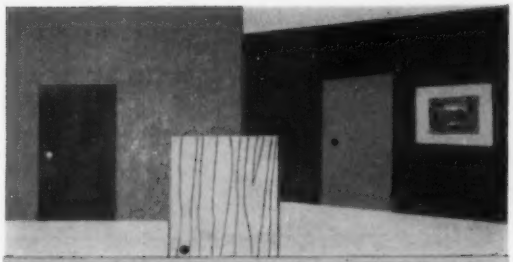

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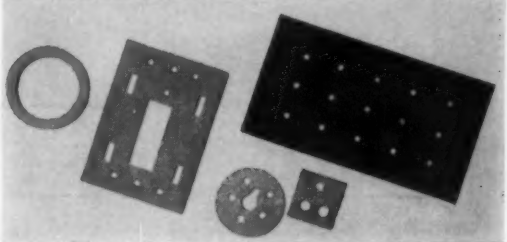

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done mechanically for at least 7 min. during which time the temperature rose to about 65° C. and the mass became much less viscous. Mixture was then poured into glass tubes which were let stand overnight to remove air bubbles. The tubes and contents were then heated at 220 ± 10° C. for 20 hr. in a circulating oil bath to complete cure.

7) Typical formulation, aromatic dibasic acid cured, with aliphatic reactive diluent: 200 g. ERL-2774; 69.6 g. pyromellitic dianhydride; 0.07 g. p,p'-methylenedianiline; 19.6 g. of allyl glycidyl ether. All components were mixed in a Waring blender for a minimum of 7 min., poured into glass tubes, and let stand at room temperature until all air bubbles disappeared. Mixture was then heated at 100° C. for 2 hr. and gradually the temperature was increased over a period of 3 hr. to 220° C. where the composition was cured for an additional 20 hours.

8) Typical formulation, aromatic dibasic acid cured, with aromatic reactive diluent: 200 g. of ERL-2774; 69.6 g. of pyromellitic dianhydride; 0.07 g. of p,p'-methylenedianiline; 24.0 g. of styrene oxide. All materials were combined in the Waring blender and stirred for 7 min. The mixture was then poured into glass tubes for settling. After a 2-hr. precure at 100° C., the temperature was increased gradually over approximately 2 hr. up to 220° C. at which temperature the composition was cured for 20 hours.

9) Another formulation, aromatic amine cured: 100 g. of ERL-2774; 15.0 g. of *m*-phenylenediamine. The *m*-phenylenediamine was heated to about 75° C. and the resin was then stirred in. This mixture was poured into glass tubes, cured at 115° C. for 30 min., and then at 210° C. for 1 hour.

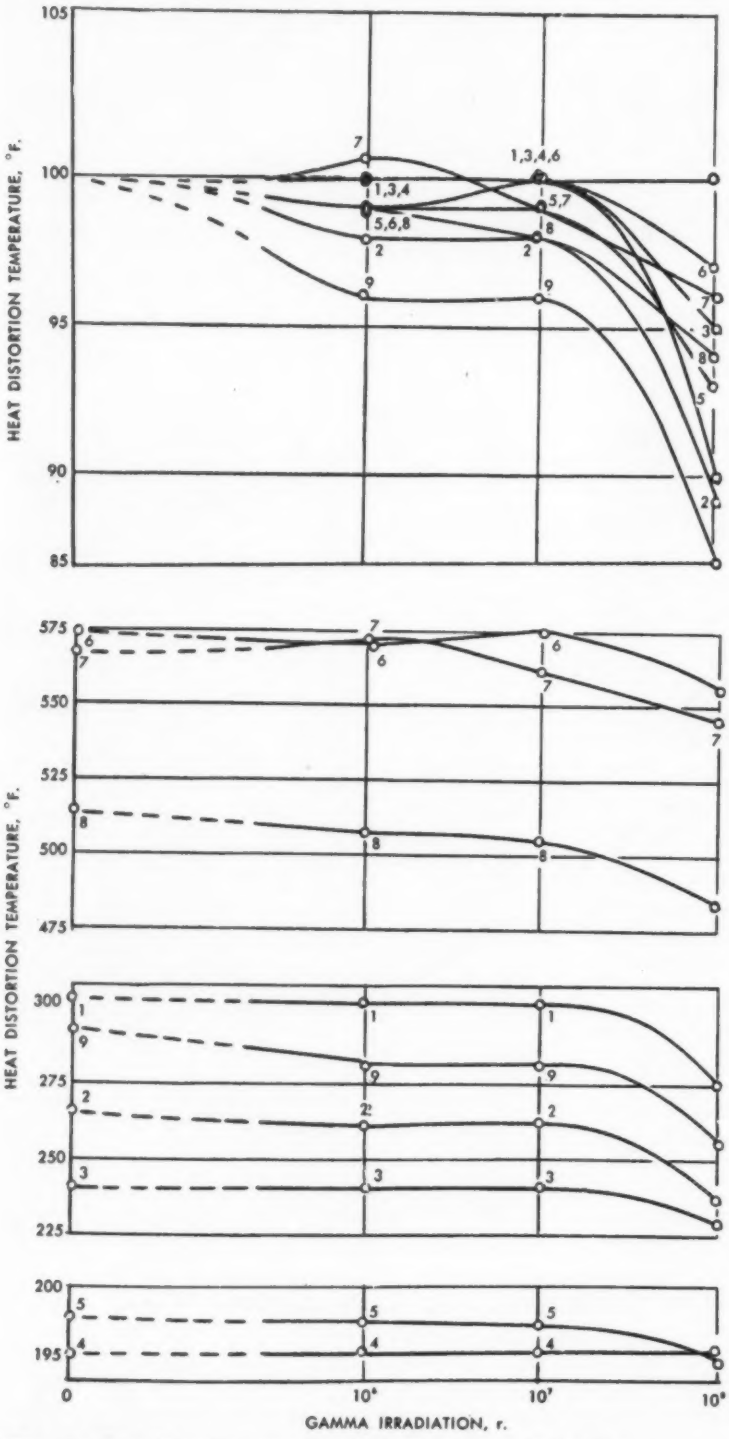

Fig. 2: Heat distortion versus irradiation for epoxy plastics. Numerals on curves refer to formulations listed under Fig. 1, p. 182

Radiation and testing procedures

It was observed in the first castings of the various epoxy plastic formulations that specimens adhered to the glass tubes during thermal curing. It was found necessary to use Dow Corning 20 Compound as a releasing agent. Procedure was to mix one part of the silicone releasing agent to three parts of carbon tetrachloride, pour this mixture into the casting tubes, and then drain out the excess. The silicone film remaining on the walls of the tube worked well when prebaked for 30 min. at the same temperature as that used later to cure the plastic composition.

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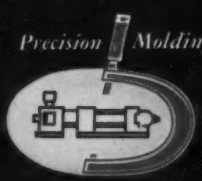

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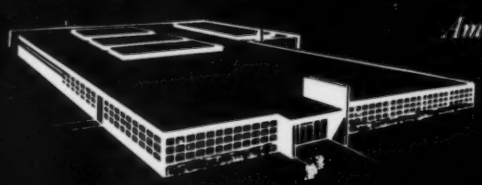

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place of thermal curing, were performed at a gamma dosage of 2×10^6 r./hr. in a 2000-curie Cobalt-60 source[1] at a temperature of about 100° F.

Radiation postcuring (at about 100 F.) was done on thermally cured rigid-epoxy cylindrical specimens, 7 in. in length and 0.385 in. in diameter. The postcuring was carried out at the Materials Testing Reactor, Spent Fuel Gamma Canal, Idaho Falls, Idaho. Intensity of radiation was about 10^7 r./hr.

[1]E. L. Colichman, P. J. Mallon, and A. A. Jarrett, "Gamma Facility for Use at High Temperatures," Nucleonics, 15 No. 4, 115-118 (1957).

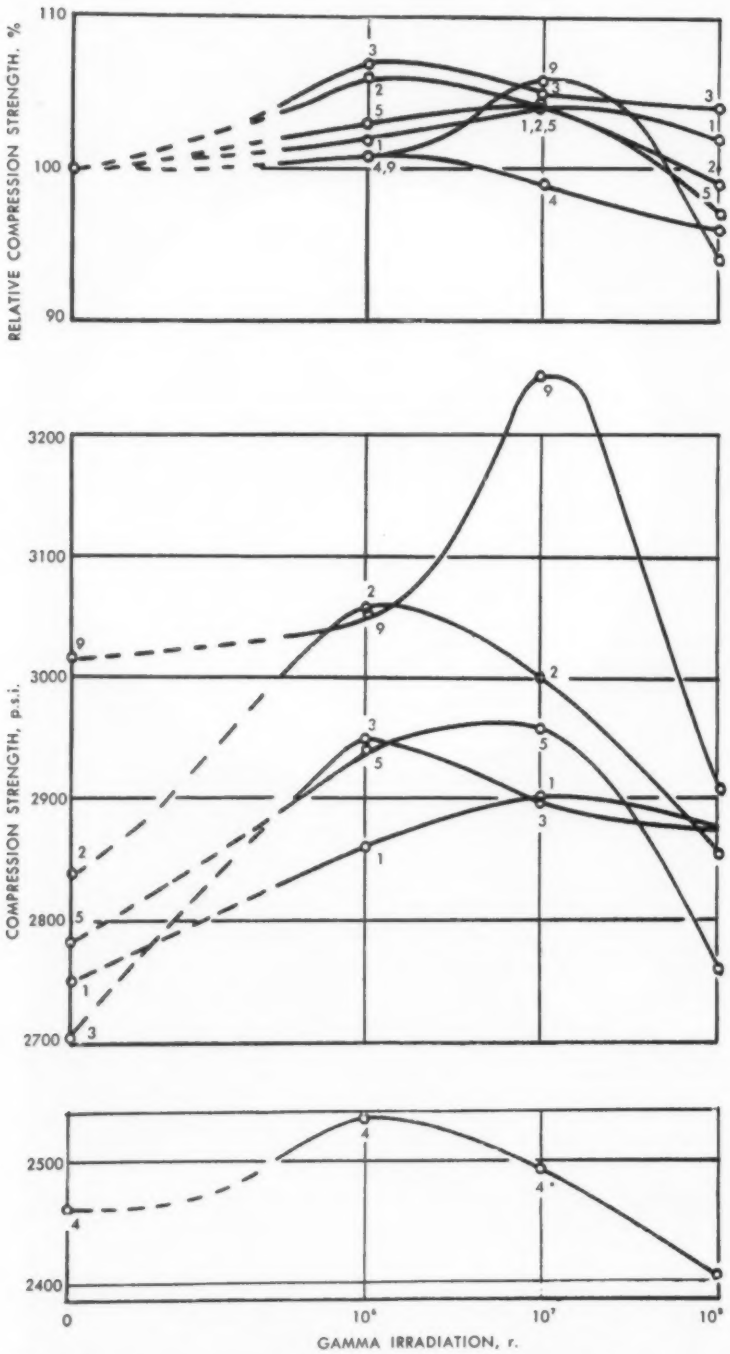

Fig. 3: Compression strength versus irradiation for epoxy plastics. Numerals on curves refer to formulations listed under Fig. 1

Hardness testing was performed with a Barcol Hardness Impressor. Heat distortion tests were made by the A.S.T.M. method using a Tinius-Olsen Heat Distortion Tester. Cylindrical rod specimens 1 in. high with a diameter of 0.385 in. (not machined) were compression tested.

Effects of radiation in postcuring

The effect of gamma radiation, as a means of postcuring already thermally cured epoxy resins, was studied by irradiating the nine different formulations at three different dosages, namely: 10^6, 10^7, and 10^8 roentgens. Three physical tests, hardness, heat distortion, and compression strength, were used to study the influence of radiation.

The various changes in these three properties for the nine different epoxy formulations are shown in Figs. 1, 2, and 3. Comparisons are made between epoxy samples that were radiation treated, i.e., after normal thermal cure, and those that were thermally cured only.

Hardness: It is seen, Fig. 1, p. 182, that radiation can be used either to increase or decrease the hardness of epoxy plastics. Changes in hardness may be interpreted as a rough measure of radiation resistance. Results obtained are highly specific to molecular structure of each epoxy composition. It would appear that:

1) The presence of normally cross-linkable groups such as those present in reactive diluents, e.g., styrene oxide and allyl gylycidyl ether, permit cross-linking by virtue of radiation-promoted vinyl-type polymerization, e.g., see *2* and *3* in Fig. 1, with a corresponding increase in hardness.

2) If the reactive group, e.g., vinyl or allyl, is present at too high a concentration, see *4* and *5* in Fig. 1, radiation polymerization takes place without significant cross-linking between polymer chains with a corresponding decrease in hardness.

3) Hardness increases can be obtained during radiation if the curing agent contains active methylene groups, e.g., p,p'-meth-

(*To page* 282)

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Plastics Digest

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General

A kinetic model for diffusion of gases in polymers. C. M. Crowe. Trans. Faraday Soc. *53*, 692-99 (May 1957). A kinetic theory is presented to account for both ordinary diffusion and thermal diffusion of gases in polymer membranes. The viewpoint is a combination of Barrer's theory of the zone of activation and of Wirtz's concept of the "place-change" process in diffusion. It is asserted that an adequate interpretation of diffusion in membranes can be made only from data for both ordinary and thermal diffusion, each studied over a range of average temperatures. The present theory predicts a variation with average temperature of the heat of transport for thermal diffusion, which has been verified for the system hydrogen and rubber. Calculated values of the parameters for hydrogen and rubber are given and the implications of the theory are discussed.

Shirtsleeve parley draws crowd of radiation experts. Chem. Week *81*, 64-66, 68 (Aug. 3, 1957). A summary of information on the effects of radiation in producing graft polymerization and solid-state polymerization as presented at the 1957 Gordon Research Conference on Radiation is given. The status of radiation studies on chemical reactions is discussed.

Materials

Anhydride curing agents for epoxy resins. H. K. Weiss. Ind. Eng. Chem. *49*, 1089-90 (July 1957). Methyl bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic, dodecenylsuccinic, and hexahydrophthalic anhydrides are effective curing agents for epoxy resins. Depending on the resin, cure schedules of 2 hours at 85° C. plus 24 hours at 150° C. or 16 hours at 120° C. to 130° C. followed by an additional hour at 180° C. produce resins with heat distortion temperatures of 78° to 143° C. when 1.0 mole of anhydride per epoxy equivalent and a tertiary amine, such as benzyldimethylamine, is used as a promoter. These low-melting anhydrides should find use where clarity, light color, long pot life, ease of handling, and/or heat distortion temperatures up to 143° C. are required.

Polymers from propylene oxide. Chem. Eng. News *35*, 24 (July 8, 1957). Isotactic and atactic propylene oxide polymers are described briefly.

Glass-flake laminates. G. Rugger. SPE J. *13*, 35-7, 70 (Apr. 1957). It has been demonstrated that a flake glass laminate can be made. While these laminates are not superior in all properties, they are acceptable for some applications in their present stage of development and are quite superior in some aspects. The aspects that are most striking are the extreme stiffness, energy absorption ability, and economy of this type of construction.

New twist in polycarbonate research. Chem. Week *80*, 57-8, 60 (June 1, 1957). Tetravalent titanium compounds are used as catalysts to polymerize bis(carbonate) monomers.

Molding and fabricating

Seamless hollow shapes of rubber or plastics. (Adapted from technical literature of Walter Opavsky Laboratories, Germany). Materials & Meth. *44*, 114-15 (Oct. 1956). Seamless hollow shapes are produced from single strips or sheets of rubber or plastics by a new process developed in Germany. Tubing and complex shapes can be produced in natural or synthetic rubber. Tubing and simple shapes can be produced in thermoplastic resins. Though particularly suitable for use with cellulosics, the process (called Holofol) is also adaptable to other thermoplastics such as polyvinyl chlorides and polyamides. The new method eliminates the need for a second sheet or for welding or heat sealing. Hollow figures are produced individually, but tubing can be produced continuously. Essentially, the process causes the dissolution of material in an area equidistant from the faces and edges of the strip or sheet. In the first step of the process, the strip is immersed in a bath of swelling agents and solvents. After a predetermined amount of swelling, heat is applied. The heat dries and shrinks the outer surfaces of the strip and drives the residual bath mixture to the center or core of the strip where the dissolving and swelling agents turn into a gas that swells the walls, forming the hollow shape. Rubber products for which the process has been used include hot water bottles, cushions, mattresses, tire tubes, technical tubing, surgical gloves, and inflatable toys. Plastics products include surgical finger stalls, surgical gloves, bandages, tube rings, sausage casings, meat and lard wrappers, technical tubing, and transparent envelopes and bags.

Applications

Acrylic coatings for metal products. G. Allyn. Materials & Methods *44*, 106-09 (Dec. 1956). A summary of the properties and applications of coatings based on acrylic and methacrylic ester resins is presented. Clear lacquers and pigmented enamels can be formulated for such applications as the preservation of attractive metallic surfaces, protection of electronic circuits from moisture, and protection of chemical and food processing equipment. The films produced are tough and durable in outdoor as well as indoor applications. Acrylic

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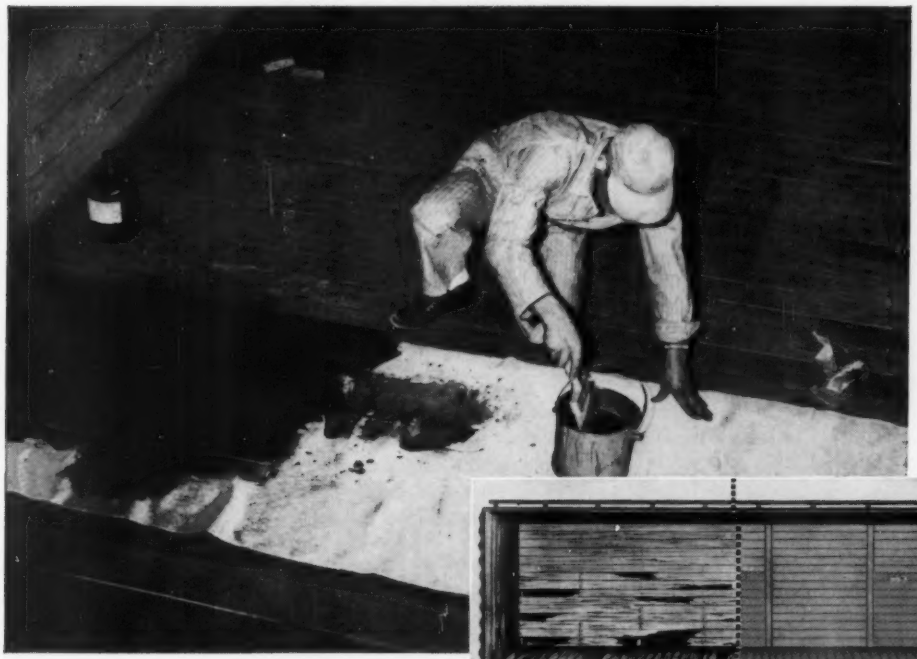

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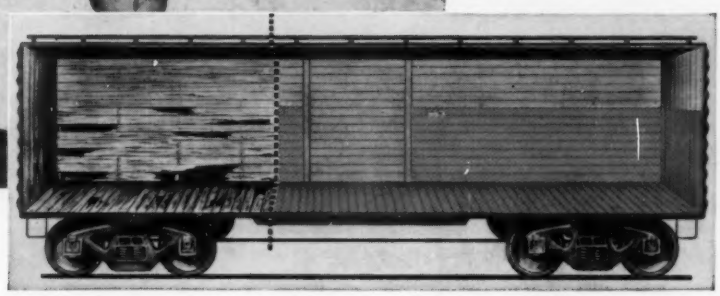

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enamels modified with silicone polymers will protect parts and retain their color at operating temperatures in the range of 300 to 500° F.

Plastic pipe in water supply use: progress in plastics. H. H. Yackey. J. Am. Water Works Assoc. *49,* 434-38 (Apr. 1957). The problems concerned with thermoplastic pipe in water service lines are discussed. Several large installations are reported to be giving good service.

Plastics for repair of mains. A symposium. Am. Gas J. *184,* 12-19 (July 1957). *Chicago: External repairs made with epoxy resins.* R. J. Detlefsen. *Milwaukee: Mains sealed internally under pressure.* E. Ungethuem. *New Orleans: Joints coated from interior.* H. M. Blain. Three approaches to repair of gas mains are outlined. Two of them, one in which broken mains and leaking joints are repaired, and the other in which large diameter pipes are sealed internally, involve the use of epoxy resins. The third method, for internally sealing leaking mains, uses a plastic in colloidal solution to impregnate joint yarn and seal it tightly. Details of application are presented and advantages and disadvantages of these methods of repair are considered.

The gas meter of the future may be made of plastic. L. A. McGowan. American Gas J. *184,* 23-26 (July 1957). With materials available today, the housing and practically all parts of the internal mechanism of a gas meter present possibilities for the use of some type of plastic. In the majority of these potential applications, an improvement in the quality of the meter would be a definite possibility.

Role of plastics in the gas industry. Gas World *146,* 123-24 (July 20, 1957. Plastics materials for use in the gas plant and other applications by the gas industry are discussed.

Reinforced plastic roof is cast at site. Eng. News-Record *159,* 63 (July 11, 1957). Details for the construction of a reinforced plastic roof cast at site are given. The advantages of such construction are: low cost, easy handling, translucence, and fire-resistance.

Styrofoam simulation of boiling and temperature effects in the EBWR (experimental boiling water reactor) cold critical experiments. J. A. DeShong, Jr. Argonne National Laboratory Report 5697, 18 pp. (Mar. 1957). Styrofoam was used successfully as a void material in the representation of hot reactor conditions during the experimental boiling water reactor zero power experiments. The void requirements were determined from available heat transfer data and then Styrofoam strips were designed and manufactured by special equipment. These strips were inserted in the fuel element water channels and the reactivity changes noted. The data were then converted to boiling and temperature coefficients. The nuclear properties of the material were excellent, and its use proved economical. The experimental accuracy was good, but probably could be improved by sealing the surface of the material against water absorption.

Properties

Effect of long-term loading on glass fiber-reinforced plastic laminates. K. H. Boller. Plastics Tech. *2,* 808-18, 820-21 (Dec. 1956). The results of one year creep tests on two glass reinforced polyester plastics and one glass reinforced epoxy plastics laminates are reported. Tests are being made in tension, flexure, and shear in air and in water for periods up to five years. The results after one year show that the stress at rupture decreases with time; that the rate of decrease is greater in water than in air; and that the tensile strains conform to the relationship, $\varepsilon = \varepsilon_o (1+t^n)$, where ε is the total strain, ε_o is the initial strain, t is the time and n is a constant.

Elevated temperature properties of reinforced plastics. I. Katz and J. Goldberg. Materials & Meth. *44,* 130-33 (Nov. 1956). Graphs are presented detailing the properties of glass-reinforced phenolic, polyester, and silicone laminates at temperatures ranging from 300 to 1000° F. Tensile, compressive, and flexural properties are considered. The weight loss during exposures at elevated temperatures is given.

Inelastic deformation of nylon under compression. C. C. Hsiao. A.S.T.M. Proc. *56,* 1425-36 (1956). The effect of rate of straining on compressive stress-strain properties of nylon at room temperature was studied. An inexpensive apparatus with a simple method for testing at moderate rates of straining was used, and many interesting properties such as the transitional stress-strain behavior from elastic to inelastic, the variation of volume and the inelastic deformation as well as the recoverable ability of the material are reported. At constant strains, the effect of log of strain rate on loading is found to be linearly related within the range of rate of straining investigated. If this linear relationship is extended, stress-strain properties at fairly low rates of straining can be extrapolated and long-time creep or relaxation characteristics of the material at high stress levels and large deformations may be derived. The possibility of describing the flow properties of the material by a family of equations is discussed. It seems that the mechanism of the flow behavior of nylon under compression may be interpreted by the Eyring molecular reaction rate theory.

Testing

Protective coating adhesion measurement using an electronic averaging device for the adherometer. A. G. Roberts and R. S. Pizer. A.S.T.M. Bull. No. 221, 53-58 (Apr. 1957). An improved adherometer is described in which the pendulum conventionally employed as a source of the stripping force needed at the cutting head is replaced with a beam and strain gage assembly. The output of the latter is fed to a specially designed electronic integrating device which yields an average value of the variable stripping force usually encountered in operation of the Interchemical adherometer. The integrometer out-

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Chemistry

Graft polymers with preset molecular configuration. F. M. Merrett. J. Polymer Sci. *24*, 467-77 (May 1957). When a graft polymer of rubber and polymethyl methacrylate is dissolved in benzene and a limited amount of methanol added, the hydrocarbon rubber chains collapse to form colloid particles stabilized by the still soluble polymethyl methacrylate chains. Similar high solids dispersions of this type and of the complementary type with the vinyl polymer chains collapsed were prepared and evaporated down to five dry modified rubbers. Due to the known incompatibility between different polymers the microseparation in the colloid suspension is carried through to the dry polymer. It is shown that the form with rubber chains collapsed, polymethyl methacrylate chains extended, is hard, shows modulus reinforcement, and adheres strongly to glass, while the form with polymethyl methacrylate chains collapsed, rubber chains extended, is soft, shows no modulus reinforcement, and does not adhere to glass. This indicates that the extended chains mainly govern these particular properties. On the other hand, good hot tear strength seems to be conferred by the *collapsed* rubber chains, the alternative form with extended rubber chains giving poor tear at all temperatures. The possibility of predicting the configuration and hence the mechanical properties given by any particular method of preparation is discussed and examples are given.

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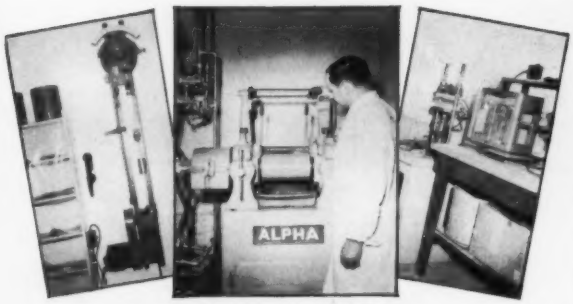

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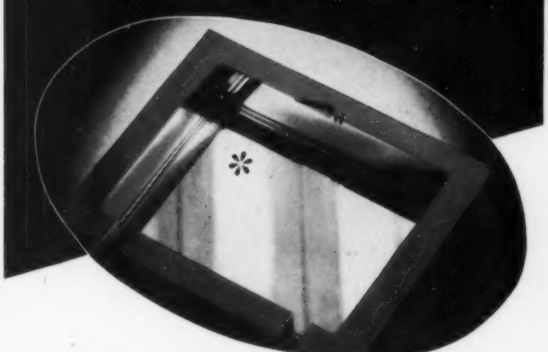

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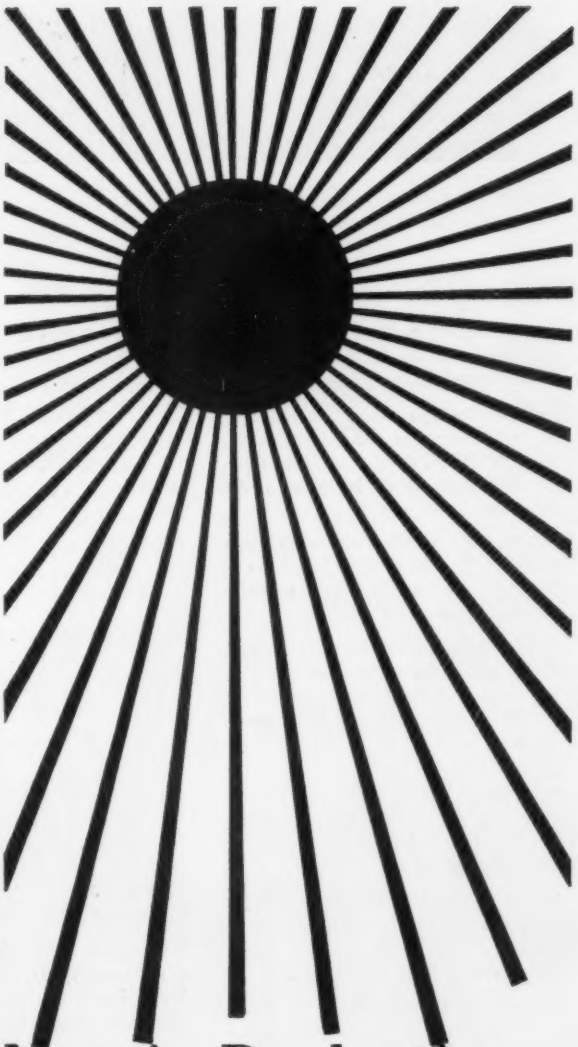

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Ion exchange. G. F. D'Alelio (to Koppers). U. S. 2,794,785, June 4. Cross-linked anion exchange resins.

Ion exchange. H. L. Segal and L. L. Miller (to Security Trust). U. S. 2,794,786, June 4. Thionin dye-ion exchange resin indicator compounds.

Gelatin. H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,794,787, June 4. Polymerizing an alkenyl carbonamide in gelatin solution.

Adhesives. H. W. Coover, Jr. and N. H. Shearer (to Eastman Kodak). U. S. 2,794,788, June 4. Adhesives containing alkyl esters of cyanoacrylic acid.

Binders. H. B. Marshall and A. C. Shaw (to Ontario Research). U. S. 2,794,790, June 4. Thermosetting binders from phenol derivatives of waste sulfite liquor.

Plastigels. T. C. Patton and F. M. Hall (to Baker Castor Oil). U. S. 2,794,791, June 4. Plastigels containing hydroxy fatty acid soaps.

Reinforced rubber. C. L. Petze (to Delaware Research). U. S. 2,794,792, June 4. Fibrous glass reinforced rubber-resin composition.

Copolymerization. H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,794,793, June 4. Copolymerization of ethenoid monomers with acrylonitrile.

Polyesters. M. J. Schlatter and J. C. Butler (to California Research). U. S. 2,794,794, June 4. Superpolyesters from ter-butyl isophthalic acid.

Polyesters. D. D. Reynolds and T. M. Laakso (to Eastman Kodak). U. S. 2,794,795, June 4. Polyesters from 4,4'-dicarblkoxybenzanilides.

Cellular resins. H. Lindemann and E. Stirnemann (to Lonza Elektrizitaets-werke). U. S. 2,795,008, June 11. Producing cellular resin bodies.

Tubular products. L. E. Caldwell and M. Riccitiello (to Westinghouse). U. S. 2,795,241, June 11. Laminated tubes.

Repair. E. S. Cobb and R. F. Burdette (to General Motors). U. S. 2,795,523, June 11. Epoxy-resin glass cloth patches for metal panels.

Web. E. A. Rodman (to Du Pont). U. S. 2,795,524, June 11. Fibrous web embedded in butadiene-acrylonitrile polymer.

Coating. H. Low (to Shell). U. S. 2,795,563, June 11. Air-drying resinous coating.

Curable composition. H. A. Newey (to Shell). U. S. 2,795,565, June 11. Hard flexible polyvinyl halide-liquid polyepoxide resin.

Resinous composition. G. M. Kosolapoff (to Monsanto). U. S. 2,795,566, June 11. Plasticized polyvinyl chloride.

Polymers. W. A. Reeves and J. D. Guthrie (to United States). U. S. 2,795,569, June 11. Ethyleneimine methylol-phosphorus polymers.

Polymers. O. Fuchs and H. Elsner (to Dynamit). U. S. 2,795,570, June 11. Halogen containing vinyl polymers stabilized with a metal salt.

Polymerization. A. K. Schneider (to Du Pont). U. S. 2,795,571, June 11. Polymerization of trioxane.

Polymers. A. C. Mueller and E. C. Shokal (to Shell). U. S. 2,795,572, June 11. Polymers of epoxy esters of carbonic acids.

Polymerization. G. R. Barrett and R. Perry, Jr. (to Monsanto). U. S. 2,795,573, June 11. Suspension polymerization of vinyl acetate and crotonic acid.

Polymerization. M. Feller and E. Field (to Standard Oil). U. S. 2,795,574, June 11. Olefin polymerization.

Polyethylene treatment. H. J. Grow, J. H. Prichard, and W. D. Paist (to Celanese). U. S. 2,795,820, June 18. Flame treating polyethylene to improve adhesion to ink.

Extrusion. T. C. Williams, Jr. (to Okonite). U. S. 2,795,821, June 18. Extrusion of textured-surfaced articles.

Surface treatment. W. M. Wooding and Y. Jen (to American Cyanamid). U. S. 2,796,362, June 18. Treating a surface with a melamine-formaldehyde - polyalkylene - polyamine resin.

Polymer. M. Baer (to Monsanto). U. S. 2,796,413, June 18. Modifying a partially hydrolyzed polyvinyl ester.

Copolymer. A. G. Lowther and F. Reeder (to Courtaulds). U. S. 2,796,414, June 18. Aminated copolymeric products of acrylonitrile with an allyl arylsulfonate.

Expansion joint. H. E. Speer, U. S. 2,796,624, June 25. Plastic expansion joint for floor covering.

Coils. E. Stegman (to E. Schenker). U. S. 2,796,631, June 25. Apparatus for coiling thermoplastic stock.

Extruder. W. H. Willert (to F. W. Egan). U. S. 2,796,632, June 25. Plastic extruder.

Molding. L. N. Chellis (to I. B. M.). U. S. 2,796,634, June 25. Forming plastic sheet.

Spinning rings. M. W. Katerman (to Magee Carpet). U. S. 2,796,727, June 25. Spinning rings of superpolyamide material.

Tubes. M. Wienand (to Dynamit). U. S. 2,796,797, June 25. Armoured plastic tubes.

Heat sealing. A. Fener and N. Langer. U. S. 2,796,913, June 25. Heat sealing and severing thermoplastic films.

Laminate. F. W. Reynolds and G. H. Kress (to I. B. M.). U. S. 2,797,179, June 25. Forming a molded laminate.

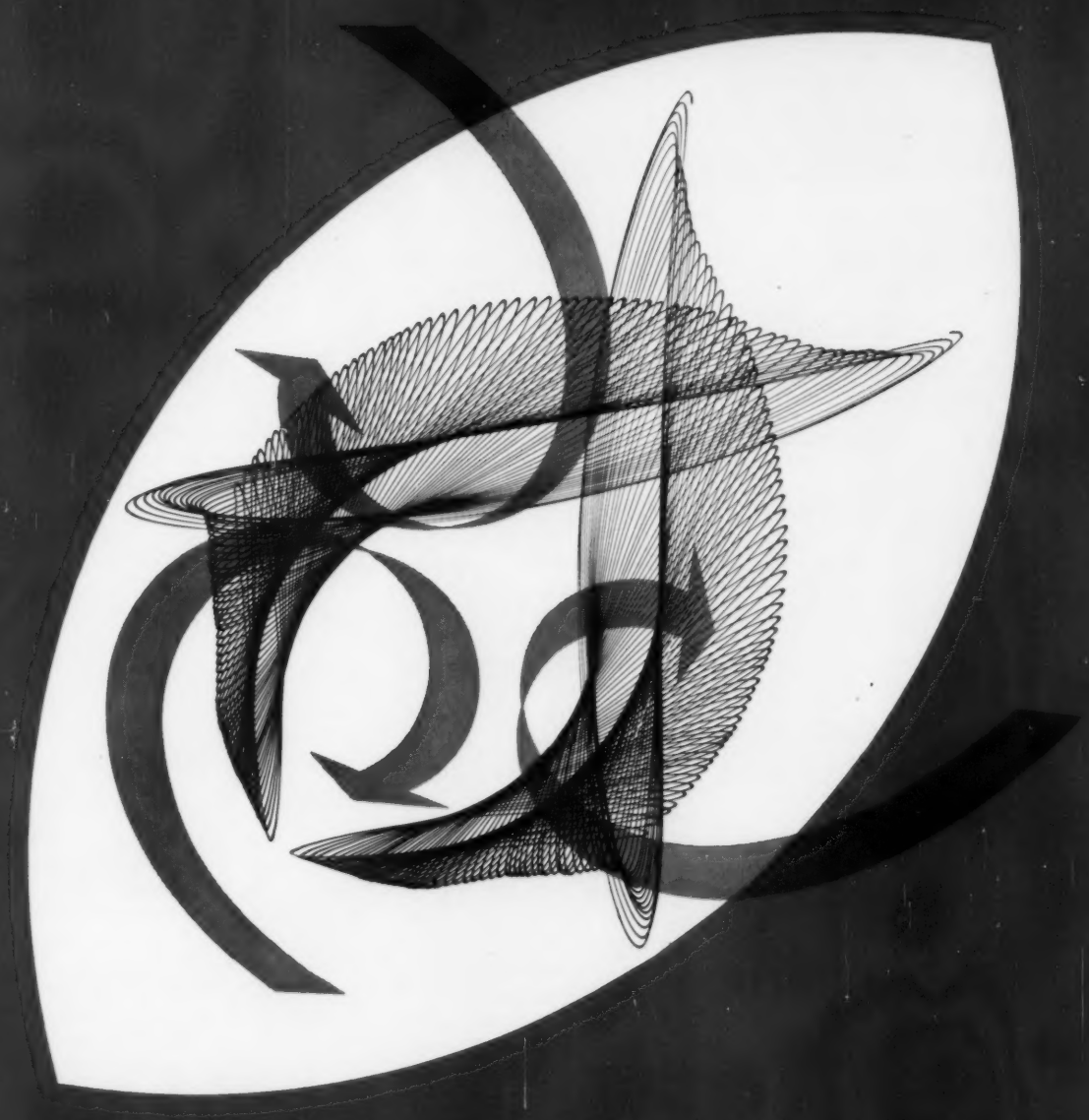
Hollow particles. F. Veatch and R. W. Burhans (to Standard Oil). U. S. 2,797,201, June 25. Forming hollow plastic particles.

Coatings. A. S. Pitre and J. R. Saroyan. U. S. 2,797,202, June 25. Modified phenolic resin coatings.

Molding compositions. E. A. Barber, B. H. Tubbs, F. B. Nagle, and A. F. Roche (to Dow). U. S. 2,797,203, June 25. Molding styrene polymers and copolymers.

Resins. W. W. Crouch (to Phillips Petroleum). U. S. 2,797,205, June 25. Mixtures of a resinous sulfur dioxide unsaturated compound with conjugated diene-unsaturated nitrile copolymer.

Resin. T. J. Suen and S. T. Moore (to American Cyanamid). U. S. 2,797,206, June 25. Stable urea-melamine resin syrup.



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Mold bases

New standard DME mold base 912-M has been designed particularly for Moslo models 73-7 and 74-7 2-oz. injection machines. The base is 9 in. wide by 11.9 in. long, with a range of thicknesses, depending on cavity depths and ejection strokes desired. Clamping, cavity, and support plates may be had in either No. 1 or 2 DME steels, the rest of the base being made of No. 1. Tubular dowels minimize interference with placement of cooling channels; welded stop pins never loosen. *Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich.*

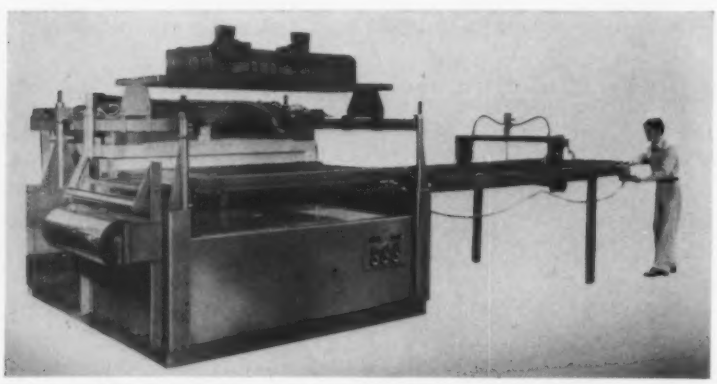
Large sheet forming machine

The Master-Vac features a forming area of 3.5 by 6 ft., with roll feed (optional extra) and semi-automatic take-off. This makes it possible for a single operator to process rolls of 5- to 15-mil material up to 44 in. wide at rates of 9 ft./min. The machine may also be used with other gages up to ⅛ inch. Maximum drape stroke is 8 in.; twin air cylinders have adjustable speeds in both up and down directions. Clamping frame is adjustable from 12 by 24 in. to maximum. Heart of vacuum system is a 5-hp., 60 c.f.m. pump backed up by a 225-gal. reservoir tank with 2.5-inch, air-operated valve. The high-temperature radiant heater has an area of 52 by 78 in. requiring 3-phase, 220-v. supply (can be 440) of 200 amp./leg. Cycle phases are controlled by three timers. Cooling of formed sheet is accomplished by two fans supplied as additional equipment. Over-all dimensions of T-shaped machine are 11 by 21 feet. *The Auto-Vac Co., 1985 State St. Ext., Bridgeport, Conn.*

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

Conveyorized oven

A conveyor belt carries the product to be heated through the heated zone of this gas-fired oven at rates adjustable from 2 to 10 f.p.m. Inside dimensions of the baking chamber are 38 in. wide by 24 in. high and 15 ft. long. Counter-balanced doors at ends can be adjusted to minimum height needed to clear product. A 1-million-B.t.u. gas burner gives top temperature of 450° F.; units can be supplied with electric or steam heating. Dimensions also can be changed to suit requirements. *Grieve-Hendry Co., Inc., 1401 W. Carroll Ave., Chicago 7, Ill.*



Master-Vac, with forming area of 3.5 by 6 ft., semi-automatic take-off, and optional roll feed, permits one operator to process rolls up to 15 mils thick and 44 in. wide at rates of 9 ft./min.

Surface finisher for sheet

Almost any quality finish can be applied on a continuous basis to sheet or film stock of various plastics by the Model 209 surface finishing machine. It can handle material up to 2 in. thick by about 4 ft. wide at rates from 16 to 66 ft./min. Designed for maximum versatility, the basic machine is available with 26 optional features or modifications. Where multiple finishing operations are necessary (e.g., finishing both sides of the sheet or web) supplementary stations with interchangeable components and a single master control can be supplied. *Clair Mfg. Co., Inc., 1002 S. Union St., Olean, N. Y.*

Sheet static eliminator

The Super Service Static Bar is square in cross section and totally enclosed. Enclosing the bar reduces maintenance since nothing can fall in to short circuit it. Only occasional brushing or blowing off is needed. Made in two sizes, ⅝ in. square in lengths up to 60 in., and 1.25 in. square in spans up to 12 feet. A complete static eliminating unit consists of one or more of these bars connected to a Power Unit. The bars are mounted so that the material to be uncharged passes close to but does not touch the bars. *Simco Co., 920 Walnut St., Lansdale, Pa.*

Fast 6/8-oz. injection machine

The model 200-H-6/8 dry-cycles at between 720 and 900 cycles/hr., depending on clamping stroke. Maximum clamping force is 200 tons, clamping stroke is 15 in. maximum with 25 in. of daylight. Clamp automatically adjusts for different mold thicknesses, cutting mold set-up time to a minimum. The hydraulic system is powered by a 30-hp. motor. Independent clamping and injection circuits allow simultaneous traversing of both rams, and the injection ram delivers up to 6 oz. normally or 8 oz. with prepacking. Dual pres-

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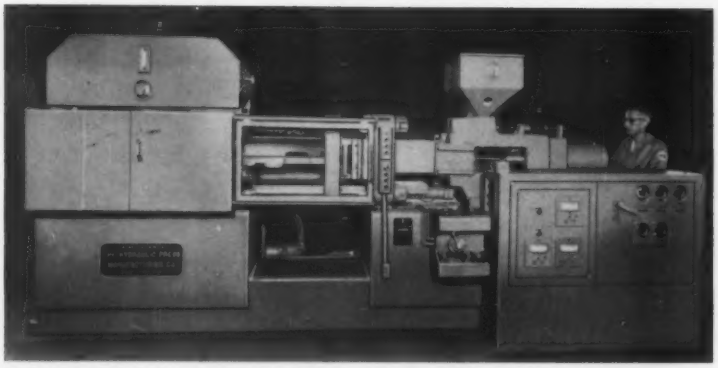

H-P-M Model 200-H-6/8 injection molding machine dry-cycles at between 720 and 900 cycles/hr., depending on clamping stroke. Clamp adjusts automatically for different mold thicknesses

sure adjustment permits lower holding pressure after mold is filled. Automatic unloading of injection pump results in savings in power, water, and pump life. A separate pilot circuit shifts valves. Platen area is 26 by 26 in., and will accept mold bases up to 15 by 26 in., either way. Ejection force is 15 tons, stroke is 4 in.; automatic clamp slow-down prevents heavy impact at ejection. Heating chamber is of one-piece construction. *Hydraulic Press Mfg. Co., Mount Gilead, Ohio.*

Low-capacity testing machines

Olsen Lo-Cap testing machines all have two range capacities—maximum and 1/5 or 1/4 of maximum, with maximum ranging from 100 to 5000 lb. in the different models. Range is changed by flicking a switch. All testing speeds from 0.3 to 12 in./min. are positively controlled under any load. Horizontal clearance between screws is 15 in.; stroke may be anything up to 36 inches. Any of these machines can be equipped with an electronic or mechanical recorder for plotting stress-strain curves. *Tinius Olsen Testing Machine Co., 7065 Easton Rd., Willow Grove, Pa.*

Screw-type injection machines

In addition to its regular line of ram-type injection machines, Ankerwerk now offers two machines with simple screw cylinders in the material is conveyed, plasticated, and injected by means of a screw. Higher capacities (for machine size) are claimed, particularly with difficult-to-plasticate materials. Injection pressure is low since only plasticated material is being displaced, with the result that projected area may be as much as 40% higher with the same clamping force. Type DV 10 is rated at 9.7 oz. of polystyrene per shot, type DV 16 at 25.7 ounces. Except for the cylinders, the parts of these new units are interchangeable with those of the standard machines. Quality of parts made on these machines from 50 materials was reported "considerably better than those produced with a piston-type machine." *Ankerwerk, Gebr. Goller, Nürnberg, Germany.*

Mixer features rubbing action

Flexible spring-steel arms, whirling against the cylindrical side of the Whirlmix, provide a rubbing action that is said to aid dry blending of granular materials. Spiral arms move material from center to periphery of mixer where contoured blade tips rub material along and upward until it falls back to the center. Rubbing action is fast, does not overheat or crush the grains. Four-cubic-foot size is equipped with fan-cooled, 5-hp. motor, totally enclosed. Other models range in capacity from 1.25 to 8 cubic feet. *Foundry Supply Co., 4611 E. 71st St., Cleveland 5, Ohio.*

Anti-static compounds

Without anti-static precautions, many plastics acquire a charge of electricity during processing operations, and this charged surface attracts dust and lint. Compounds available in all standard bar sizes combine an anti-static agent with special soft abrasive to produce a scratch-free, dust-free surface. Tests show that anti-static properties are retained through 100 or more handlings. Under development for spray applications is a companion liquid compound. *Hanson - Van Winkle - Munning Co., Grand Rapids, Mich.*

Mold release for urethane foam

Perma Mold is a ready-to-use liquid that is wiped onto mold surfaces with a cloth. Foamed isocyanates and urethanes release easily from molds treated once every few cycles. Perma-Mold does not vaporize at molding temperatures. *Brulin and Co., 2939-45 Columbia Ave., Indianapolis 7, Ind.*

Vibration pad supports 50 p.s.i.

Shear-Flex is a two-way-ribbed Neoprene pad that can be cut with knife or scissors to the desired shape. Capable of supporting (compressive) loads up to 50 p.s.i. in vibration, the pad does not need to be bolted down. It serves most effectively in applications where the disturbing frequency of vibration is two or more times the natural resonant frequency of the system. Flex-Plates of several types are available with Shear-Flex to accommodate all types of machine feet, including, if desired, several bolt-down arrangements. *Vibration Mountings, Inc., 98-25 50th Ave., Corona, N.Y.*

Freezeproof rotary joint

The new Exacto rotary joint is guaranteed to eliminate seizing or freezing on the roll. The standard unit operates at steam pressures up to 250 p.s.i., temperatures up to 500° F., and speeds up to 1000 r.p.m. Other features include flexible shaft alignment, packless and self-lubricating bearing surfaces, and low minimum turning torque. Sealing members function independently of the operating load. All sizes between ½ and 1.5 in. are available. *Phillips Sales Co., P.O. Box 417, West New York, N. J.*

Laboratory two-roll mill

A two-roll mill having rolls 6 in. in diameter by 16 in. long is designed for laboratory processing

of small quantities of rubbers and plastics. One roll turns at 20 r.p.m., 23% faster than the other, providing a strong milling action in the nip of the rolls. Rolls are hard-chromed, hollow with internal spray, powered by 7.5-hp. motor with chain-and-sprocket drive. Dimensions are 37.5 in. wide by 29 in. deep by 58.5 in. high. *Todd Shipyards Corp., P. O. Box 231, San Pedro, Calif.*

Bigger hopper loader

The 1000 series hopper loader has a capacity of 1000 p.p.h. of average molding material—twice that of the same maker's 500 series. It handles all free-flowing materials, even (with filter cone attachment) dry-colored materials. The extra height of this model makes it possible to use it with all containers on pallets. Maintains constant level in machine feed hopper. *C. H. Whitlock Associates, 21655 Coolidge Highway, Oak Park 37, Mich.*

Mold chiller

The RWW-400 and -600 packaged water chillers, in 3- and 5-hp. sizes, are equipped with field serviceable compressors and air-cooled motors. These units have a refrigerating capacity of about 2.5 and 4 tons, depending on operating conditions. With chilled water entering the unit at 50° F. and leaving at 40° F., the flow rate is about 5.6 g.p.m. in the RWW-400, 9.1 g.p.m in the bigger unit. Power requirements under these conditions are 3.3 and 5.0 kw. Over-all dimensions on both units are: 44.8 in. wide by 26.8 in. deep by 32 in. high. A safety thermostat set for 38° F. protects chiller against freeze-up. Unit does not include pumps for circulation of chiller water and condenser water. *Worthington Corp., Harrison, N. J.*

1-ounce injection machine

Air-powered, the Model 50 Jet Wasp Mini-Jector is a pushbutton-controlled injection machine especially useful for molding moderate quantities of small parts, particularly parts requiring inserts. Capacity may be changed quickly from ⅛ oz. to 1 oz. by simply interchanging cylinder, ram, and heater box. It molds all

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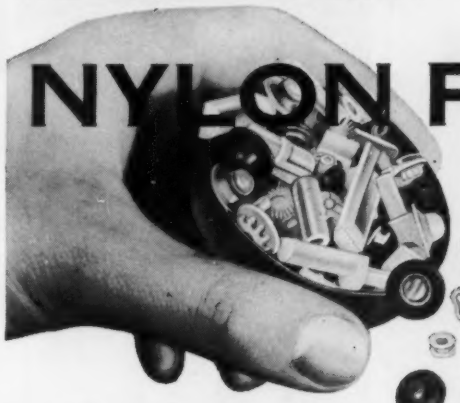

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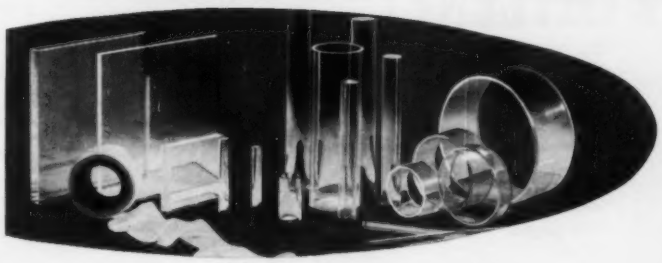

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The 5M series of automatic spray-mask painting machines was designed specifically for masked painting of small parts that normally would not warrant the cost of such techniques. They can handle a wide variety of shapes and contours, and, under certain conditions, can handle more than one color at a time. Three stationary-gun models accomplish the simpler types of painting with 2, 3, or 4 fixed guns. Four models are fitted with one or more oscillating guns to handle the more complex jobs. Any of the seven can be

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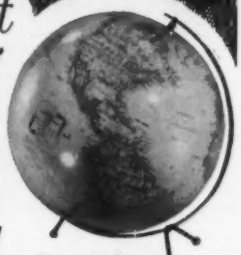

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fitted with a removable rotary spray station; all are air-operated. Over-all dimensions on all seven are: width, 26 in.; depth, 23 in.; height, 42 inches. Mask openings are 18 by 10.5 inches. *Sepanski and Associates, 900 Clancy Ave. N. E., Grand Rapids, Mich.*

Hydraulic equipment line

A custom maker of hydraulic press brakes and presses now offers equipment for the plastics industry. Examples of available machinery are two 4-column, two-ram presses. Both machines, one a down-stroke type, the other an up-stroke type, have a capacity of 100 tons. Ram platens are rectangular, measuring 19 in. deep by 46 in. wide. Bed areas are 23 in. deep, same width. High- and low-pressure pumps connect to 440-v. source. Customer's needs regarding heating and cooling facilities will be met. *Superior Machine Co., 1389 Heistan Pl., Memphis 4, Tenn.*

One of the machines in a new line of hydraulic presses developed by Superior for the plastics industry. High- and low-pressure pumps connect to 440-v. source

Correction

The cycle time of the Fellows No. 12-350 12-oz. injection machine was incorrectly reported in our September issue, p. 200. The correct dry-cycling time is 5.2 seconds.

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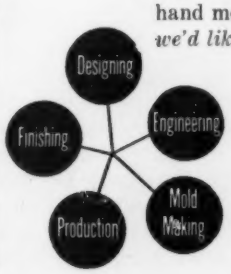

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Books & Booklets

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"Technical Data on Plastics"

Published in 1957 by the Manufacturing Chemists' Association, 1625 Eye St., N.W., Washington 6, D.C. 213 pages. Price: $3.25.

Like earlier editions, this is mainly a collection of up-to-date data on thermosetting and thermoplastic resins. A brief description is given of each important compound, including trade designations and what they mean. Properties are tabulated much as they are in the MODERN PLASTICS Encyclopedia Issue properties chart, except that the information is much more specific and voluminous. For a number of materials there is additional information, such as stress-strain charts, impact strength vs. temperature, supplementary data on chemical resistance, etc. Molders, extruders, and processing equipment designers will probably rue the lack of data on variation of thermal and flow properties with temperature, but product designers should find the book very valuable.

"Transactions of the Society of Rheology. Vol. I. 1957"

Edited by Bryce Maxwell and R. D. Andrews

Published in 1957 by Interscience Publishers, 250 Fifth Ave., New York 1, N.Y. 222 pages. Price: $6.00.

This is a collection of 15 papers on the flow behavior of materials ranging from suspensions of dumbbells to plastisols to titanium alloys. Most of the papers deal with flow of plastic melts and solutions. Of particular interest to plastics engineers will be these: Toor: "Heat generation and conduction in the flow of a viscous compressible liquid;" Severs and Austin: "The thermal incline—a means of measuring viscosities of plastisols at elevated temperatures;" and Tordella: "Capillary flow of molten polyethylene—a photographic study of melt fracture."

"Chemical Engineering Reports. 4th Ed."

By Kenneth A. Kobe

Published in 1957 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. 183 pages. Price: $3.00.

Subtitled "How to search the literature and prepare a report," this is the most refreshing book to appear on this subject since "Technical Report Writing," by F. H. Rhodes. There are twelve chapters dealing with literature searching, types of reports, letters, what should be in the formal report and the laboratory report, mechanical preparation (including useful information on various reproduction processes for text, drawings, and photos), literature citations, and, particularly valuable, effective writing. Appended are reprints of a two-part article by Tichy, "Engineers can write better." Engineers should find this book very helpful in overcoming the principal problem of report writing: poor writing. Photo-offset printed from double-spaced typescript with exceptional clarity.

"France Plastiques"

Published in 1957 by Société de Créations Éditions et Productions Publicitaires, 27, Rue Laffitte, Paris IXe, France. 1065 pages. Price: 2700 F. (ca. $7.75).

The ninth edition of this annual yearbook of the French plastics industry provides a classified guide of materials makers, machinery and equipment manufacturers, molders, fabricators, importers, and distributors. Listings of trademarks, manufacturers' societies, educational institutions, and publications are included.

Acrylic paint. "Basic Concepts of Acrylic Emulsion Paint Technology" summarizes the development of water-thinned paints, the technology of acrylic emulsions, acrylic paint formulations, manufacture, equipment used, application, and properties, and includes a general discussion of exterior acrylic coatings. 12 pages. *Rohm & Haas Co., Washington Sq., Philadelphia 5, Pa.*

Fibrous sheet. Data on physical properties, heat and chemical resistance, potential uses, and availability of Armalon products, which consist of Teflon tetrafluoroethylene resin in the form of fibrous sheets for filtration and other uses. New Products Bulletin No. 6. 3 pages. *E. I. du Pont de Nemours & Co., Wilmington 98, Del.*

Plastics fabrication. Examples of plastics fabrication methods—blow forming, vacuum forming, and reinforced plastics laminating—with illustrations of products. Chart shows characteristics of tough, rigid thermoplastics. 12 pages. *Plastics Div., L. A. Darling Co., Coldwater, Mich.*

Silicones. The 1956 Edgar Marburg Lecture, "The Industrial Chemistry, Properties, and Applications of Silicones," by Charles E. Reed. Price: $1.50. 47 pages. *American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.*

Fungicidal coatings. Report PB 121913, "Weathering Resistance of Fungicidal Vinyl Coated Cotton Fabrics," reports on coatings which contain the fungicide copper 8-hydroxyquinoline (Cu-8-Q). Price: $1.00. 40 pages. *Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D.C.*

Melamine plastic dinnerware standard. "Melamine Dinnerware (Alpha-Cellulose-Filled) for Household Use, Commercial Standard CS210-57" specifies chemical and physical properties

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and methods of test. Price: 10¢. *Superintendent of Documents, Government Printing Office, Washington 25, D.C.*

Vinyl chloride garden hose. Requirements and test methods for burst strength, low-temperature flexibility, water extraction, water flow rate, couplings, appearance, concentricity, inside diameters, and tolerances are established in "Vinyl Chloride Plastics Garden Hose," CS209-57, a commercial standard. A recommended statement for declaring compliance with the standard and an identifying hallmark are included. Price: 10¢. *Superintendent of Documents, Government Printing Office, Washington 25, D.C.*

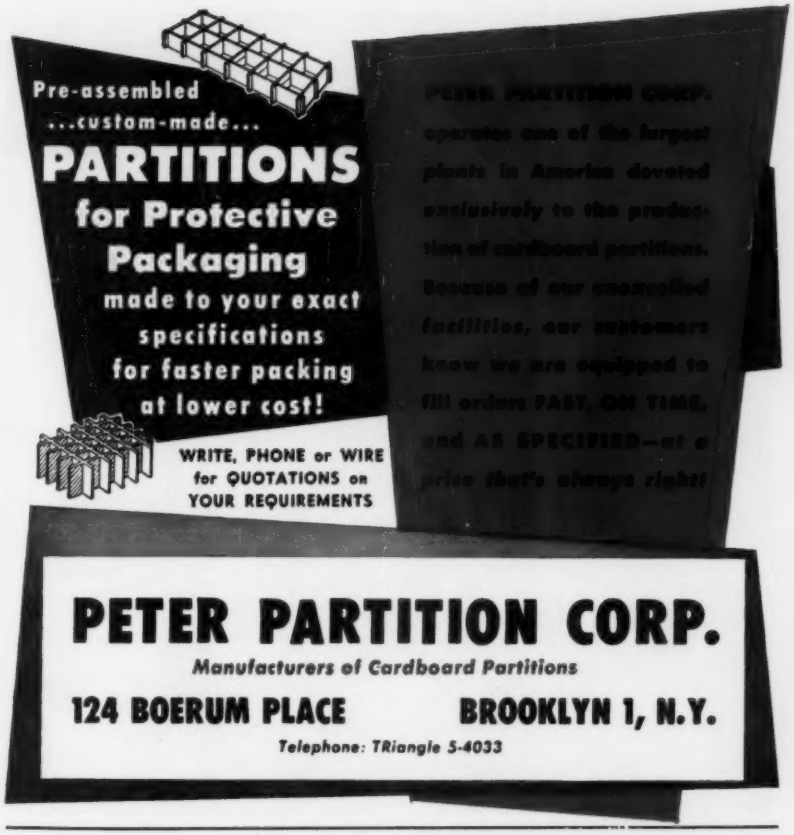
"Simple Arithmetic in Packaging," a color sound slidefilm, documents the savings in materials handling and packaging made possible by various types of corrugated bulk containers. Film may be borrowed from *Gaylord Container Corp., Div. of Crown Zellerbach Corp., 111 N. Fourth St., St. Louis 2, Mo.*

Plasticizer. Data on general properties, specifications, resin and solvent compatibility, typical formulations, toxicity, and shipping for dicyclohexyl phthalate, a plasticizer for nitrocellulose lacquers. Technical Bulletin No. O-136. 6 pages. *Monsanto Chemical Co., Organic Chemicals Div., St. Louis 1, Mo.*

Plastics molding. Description of company's facilities and services for compression, transfer, and injection molding, and its associated operations of mold making, engineering and design, research, and assembly. 4 pages. *Waterbury Companies, Inc., Waterbury 20, Conn.*

Mixers. Complete lines of double-arm, spiral-ribbon, and vertical mixers suitable for either laboratory and pilot plants or for commercial production. 8 pages. *Read Standard Div., Capitol Products Corp., York, Pa.*

Double dome skylight. Examples of the uses and benefits of double dome skylights. Specifications for



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the three standard types—standard self-flashing, bond self-flashing, and curb-mounting. 4 pages. *Corrulux Div., L-O-F Glass Fibers Co., P.O. Box 20026, Houston 25, Texas.*

Polyvinyl dispersion. Properties and some of the applications of Chem-o-sol, a specially formulated high molecular weight polyvinyl dispersion. Bulletin No. 143. 12 pages. *Chemical Products Corp., King Philip Rd., E. Providence 14, R.I.*

Chemical processing machinery. Design features and specification tables of mixers, blenders, sifters, roll mills. Bulletin No. 557. 4 pages. *The J. H. Day Co., Div. of The Cleveland Automatic Machine Co., Cincinnati 12, Ohio.*

"Plastic Tooling Symposium." Eight technical papers and a panel discussion embracing four separate lectures given in conjunction with the recent ASTE Silver Anniversary Convention in Houston, Texas. Five additional papers presented at the 1955 and 1956 Annual Meetings are included. Price: members, $5.00; non-members, $10.00. *American Society of Tool Engineers Technical Papers, 10700 Puritan Ave., Detroit 38, Mich.*

PVC pipe. Tables of sizes, chemical applications, physical properties, temperature factors for various working pressures, support spacing, and thermal expansion of regular and high impact corrosion-resistant rigid polyvinyl chloride pipe. Bulletin A 557. 12 pages. *Alpha Plastics Inc., 78 Okner P'way, Livingston, N.J.*

PVAc emulsions. Compounding and application techniques, and a wide variety of typical application formulations for Gelva KR, polyvinyl acetate emulsions used as a finish for cottons and synthetics to improve hand and stiffness. 12 pages. *Shawinigan Resins Corp., Springfield 2, Mass.*

Wallcovering fabrics. Typical examples of the use of Vicrtex V.E.F. (vinyl electronically fused) wallcovering fabrics for homes, stores, bars, restaurants, banks, offices, etc. A.I.A. File No. 28-C. 4 pages. *L. E. Carpenter & Co., Inc., Empire State Bldg., New York 1, N.Y.*

Metallic epoxy putty. Description of A2 series of aluminum-filled epoxy resin compounds for repair and maintenance work requiring a chemically stable, non-shrinking, and non-flammable putty with good adhesion to iron, steel, aluminum, wood, glass, or ceramics. Bulletin No. 11. 4 pages. *Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City 4, N.J.*

Materials preservation. "Symposium on Preservation for Mobilization Requirements," PB 131007, a recently held joint military-civilian conference, includes some 40 papers covering a wide range of problems in the prevention of deterioration of materials and equipment. Preservation materials such as Teflon, organic coatings, and liquid corrosion in-

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hibitors are also dealt with. 524 pages. Price: $8. *Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.*

"ASTM Proceedings," 1956 edition, gives reports of 80 technical committees with appendices, 52 technical papers on a wide variety of subjects, and includes the 1956 annual address given by Pres. C. H. Fellows, "The Challenge of Nuclear Energy Accepted by the Electric Power Industry and ASTM," 1510 pages. Price: $12. *American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.*

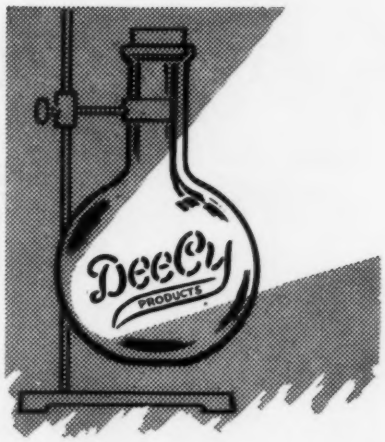
Precipitated calcium carbonates. "Diamond Precipitated Calcium Carbonates for Polyvinyl Chloride Applications" reviews the use of eight chemicals as inert fillers for compounding polyvinyl chlorides plastics products. 16 pages. *Diamond Alkali Co., Silicate-Detergent-Calcium Div., 300 Union Commerce Bldg., Cleveland 14, Ohio.*

Industrial marking equipment. Data on entire line of marking, dating, and coding machines; outline of base lock types and logos; and information on custom-designed marking machines for special applications. 8 pages. *Industrial Marking Equipment Co., Inc., 454 Baltic St., Brooklyn 17, N.Y.*

Cycling timer. Application and operation data, together with time ranges, ratings, material and construction specifications for Cramer Type 571, a new motor-driven cycle timer. Bulletin sheet PB-571. *Cramer Controls Corp., Centerbrook, Conn.*

"Carbide Tipped Saws and Tools." How carbide cutting edges can solve cutting problems encountered with plastics, fibre, wood, and non-ferrous metals. 24 pages. *Saw Div., R. Hoe & Co., Inc., 910 E. 138th St., New York 54, N.Y.*

Rack jobbers. Over 800 listings, a 15-page editorial report, and a geographical and alphabetical listing of rack jobbers is given in the second revised edition of the



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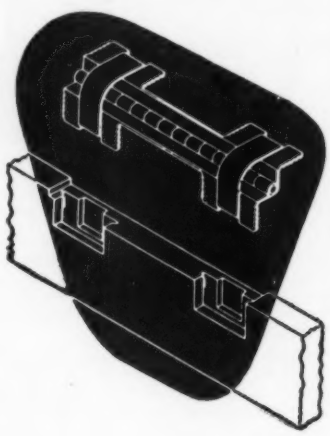

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"National Directory of Rack Jobbers." Price: $15. 219 pages. *Gale Research Co., 1116 Book Tower, Detroit 26, Mich.*

Company activities. Brochure covers company facilities, laboratory equipment for research and development, chemical products, government research laboratory experience, and personnel and their experience. 11 pages. *Compo Chemical Co., Inc., 125 Roberts Rd., Waltham 54, Mass.*

"Chemical Resistance of Plastics," PB 121133. Results of tests on 25 thermoplastic and thermosetting plastics with 15 chemical agents. From the data, it is possible to deduce the behavior of any given plastic on immersion in a given agent, and the change in certain key physical properties as a result of prolonged contact. Price: $9. 475 pages. *Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C.*

Company services. Description of services offered by the company in low temperature pulverizing of molding compounds with liquid nitrogen, reprocessing fluorocarbons, supplying purified color pigments, and research and development. 3 pages. *Liquid Nitrogen Processing Corp., 451 Booth St., Chester, Pa.*

Price list. Schedule of prices for epoxy and phenolic materials used for laminating, surface coats, and casting. Accessories and fibrous glass fabrics and tape are also listed. 6 pages. *Rezolin, Inc., 1651 18th St., Santa Monica, Calif.*

Static. "I Asked My Daddy About Static" poses a number of questions that daddy answers (in cartoon form) about the company's metal encased, channel, and shockless static bars. 4 pages. *The Simco Co., 920 Walnut St., Lansdale, Pa.*

"Heating Laminated Plastics." Description of methods and definite procedures set up for hot-punching laminated plastics. Bulletin No. 28. 3 pages. *Continental-Diamond Fibre Corp., Newark, Del.*

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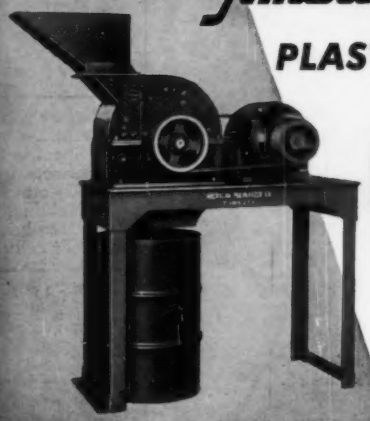

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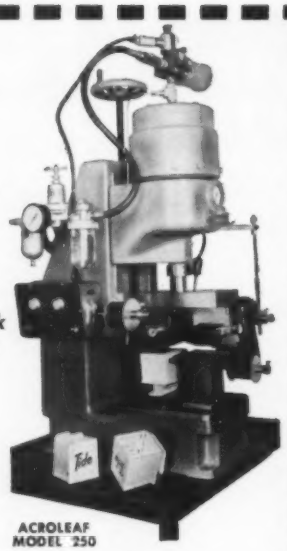

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Production and sales figures in 1000 lb.* for May and June 1957

Materials	*Total p'd'n first 6 mos. of 1957‡*	*Total sales first 6 mos. of 1957‡*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	9,832	9,262
Sheets, 0.003 gage and over	9,132	8,679
All other sheets, rods, tubes	3,645	3,547
Molding, extrusion materials	45,566	44,315
Nitrocellulose sheets, rods, tubes	2,224	2,200
Other cellulose plastics	2,862	2,450
Phenolic and other tar-acid resins:		
Molding materials[a]	93,185	89,334
Bonding and adhesive resins for:		
Laminating (except plywood)	30,711	23,348
Coated and bonded abrasives	8,954	8,302
Thermal insulation	25,286	24,532
Plywood	23,598	17,636
All other bonding uses	27,201	25,757
Protective-coating resins	15,910	13,098
Resins for all other uses	19,409	16,897
Urea and melamine resins:		
Textile-treating resins	18,868	18,096
Paper-treating resins	13,536	12,104
Bonding and adhesive resins for:		
Plywood	46,779	45,382
All other bonding and adhesive uses, including laminating	14,507	13,629
Protective-coating resins	18,691	14,209
Resins for all other uses, including molding	46,473	45,441
Styrene resins:		
Molding materials[a]	206,480	198,169
Protective-coating resins	41,884	39,524
Resins for all other uses	74,812	61,087
Vinyl resins, total[b]	408,842	379,512
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		47,127
Sheeting (resin content)		27,414
Molding and extrusion (resin content)		112,326
Textile and paper, treating and coating (resin content)[c]		30,718
Flooring (resin content)		40,712
Protective coatings (resin content)		17,641
All other uses (resin content)		23,249
All other vinyl resins for:		
Adhesives (resin content)		21,333
All other uses (resin content)		59,016
Coumarone-indene and petroleum Polymer resin:	123,189	124,897
Polyester resins:	48,734	43,492
Polyethylene resins:	322,818	313,119
Miscellaneous:		
Molding materials[a,d]	23,720	23,493
Protective-coating resins[e]	6,559	3,190
Resins for all other uses[f]	65,185	59,632

*Dry basis designated unless otherwise specified. †Revised.
‡Partially estimated. ¶Includes friction materials.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

May†		*June‡*	
Production	*Sales*	*Production*	*Sales*
1,510	1,527	1,796	1,756
1,585	1,570	1,570	1,578
562	585	729	599
7,672	7,512	7,794	7,433
412	376	270	295
466	481	468	422
15,559	16,452	13,877	13,384
5,171	4,314	4,986	3,623
1,860	1,624	1,013	967
4,039	4,199	4,645	4,263
4,428	3,534	4,013	2,843
5,164	5,099	4,781	4,586
3,072	2,163	2,431	1,992
3,030	2,502	3,001	2,581
3,368	2,911	2,338	2,373
1,888	1,910	2,318	2,057
8,492	7,837	6,948	7,434
1,912	2,370	3,038	2,334
2,957	2,088	2,911	2,375
8,311	8,134	7,293	6,522
35,322	33,015	31,394	24,178
7,389	7,644	5,550	5,201
13,276	10,930	11,948	8,470
71,363	63,162	67,280	59,558
	7,641		7,098
	3,765		3,861
	18,218		17,195
	4,628		4,688
	7,519		6,245
	3,227		2,362
	4,388		3,791
	3,404		4,467
	10,371		9,851
23,586	23,856	17,083	18,072
8,525	8,393	8,178	7,199
56,170	59,504	56,074	51,037
3,731	3,638	3,491	3,425
940	599	1,008	499
11,387	9,643	11,323	9,559

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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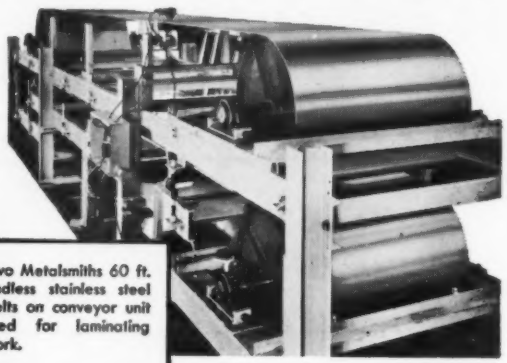
of sheets—film—coatings—laminated work, etc.



Two Metalsmiths 60 ft. endless stainless steel belts on conveyor unit used for laminating work.

Many advantages are gained by using "Metalsmiths" endless belts in processing work. It improves and speeds up heating, cooling, conditioning and setting. Highly polished surface provides automatic contact gloss. Adapted to many special requirements. "Metalsmiths" Stainless Steel (18-8) belts are available in any length and extra wide sizes. One piece, no center seam, polished or unpolished, width and camber controlled. Consult our engineers. Metalsmiths, 558 White St., Orange, N.J.

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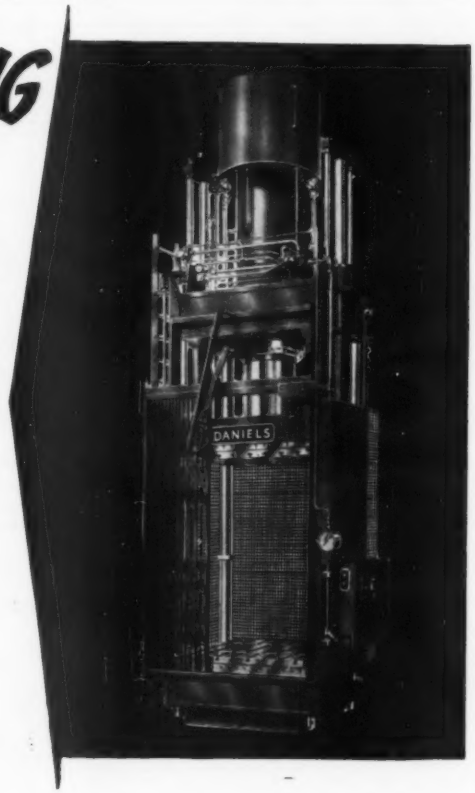
with this

100 TON LOW PRESSURE PRESS

This is the first Press designed and produced in Great Britain for moulding reinforced Plastics materials. It is much larger than the conventional compression moulding press, having tables 4 ft. x 3 ft., a maximum daylight of 7 ft. and a 4 ft. stroke. To prevent heat from the moulds affecting the press, both the fixed and moving tables are drilled for cooling water. Hydraulic working pressure is 1000 lbs. per sq. in., giving a maximum moulding pressure of 100 tons, but the moulding pressure may be set at any figure between 10 and 100 tons. A slowing device is incorporated which can be set to operate at any portion of the stroke allowing for very slow final closing on the moulded article. The press is a self-contained unit with single stage vane-type pump, 12½ h.p. motor, hydraulic piping and valves.



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The Platform

Where readers may voice their opinions on any phase of or problem in the plastics industries, controversial or otherwise. The editors of MODERN PLASTICS take no responsibility for opinions expressed in letters herein.

The Editor, MODERN PLASTICS:

There now appear to be no general-purpose plastics. Our Age of Specialization seems to have applied itself to materials as thoroughly as to men.

Originally "substitute" materials for wood and common metals, plastics today owe their real growth to those applications where their specific properties were found to readily fit a particular need.

In a mature stage of development, plastics are no longer chosen merely because of fabrication or assembly economies. Their steadily increasing volume is now attributable to their *intrinsic value*, determined by engineering design properties, and their acceptance on this basis (rather than on that of price alone) by end-use consumers.

Within the plastics industry, the standard of this value has historically been the phenolic materials—traditionally the economic leader of the industry.

Despite this fact, the portion of the market for molded plastics parts which phenolics have retained has significantly decreased in recent years. Logically, this relative change in the market for phenolics has placed greater emphasis on the fundamental reasons for their use in current applications.

The resultant recognition is that phenolics are no longer general-purpose materials, but, in fact, are *special*-purpose plastics, which render economies and services met by no other materials of construction.

In spite of more than 50 years of accelerating development of new plastic materials, phenolics alone continue to excel in heat resistance, dimensional stability, and resistance to creep under load.

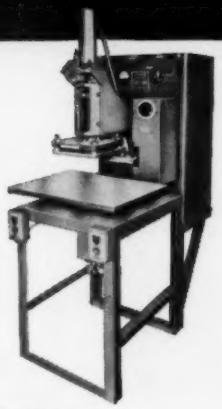
The real value to the economy provided by phenolics rests on these outstanding engineering properties, and as such warrant renewed emphasis and attention on the part of design engineers, product planners, and value analysts.

In this connection, it is interesting to note that recent new applications for phenolic moldings have been the result of conversion from other, non-plastic materials. In these applications phenolics have been selected because their special design properties were best suited of all the materials available for these particular jobs. Specific examples are the growing use of phenolics in new automatic appliances and in certain applications of glass-reinforced phenolics in gears and cams. Of equal significance is the fact that the materials used in these jobs are not the familiar, general-purpose phenolics, but specialty grades, engineered to enhance the three outstanding characteristics. Still broader fields of application of phenolics are suggested by these specialty applications.

Continued expansion of phenolic use can result from a singleness of purpose on the part of molders and material suppliers. Every effort must be made to revitalize the market for phenolics, and to acquire deserved recognition for the *value* of phenolic molded parts.

This can be done through:

1) Continuing process development programs designed to reduce molding cycles and machine times, to compare favorably with other materials. Such work now being done by some individual com-



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panies has resulted in reductions in overall cycle times of up to 70 percent.

2) Institutionalizing phenolics by an industry-wide program of individual company advertising and promotion.

3) Concentrating application research and technical development to exploit the special properties of phenolics.

Such an approach would attempt to base new uses of phenolics on their value as a specialty material. Continued expansion of the phenolics industry requires such intensive effort.

E. M. Irish, Jr.,
Phenolic Products Sales Manager,
Chemical Materials Dept.,
General Electric Co.

The Editor, MODERN PLASTICS

Flexible polyurethane foam is a remarkable material when properly used. One can, however, cite many examples of flagrant misrepresentations of its correct applications that are made to the general public.

A case in point is the attempt to market this material as a common household sponge. I have seen housewives and boatsmen terribly disappointed because such "sponges" do not absorb water.

As everyone familiar with these materials knows, one can pour water on them all day long and they will remain essentially dry. In the home and on a boat they can be used as cushioning materials and as lint removers. But they will never replace the cellulose sponge.

To suggest that such a material can properly be used as a sponge is, in my opinion, outright misrepresentation of the fact.

The time to fight the vendors who will kill the goose that lays the golden egg is now. Your magazine should be a leader in this effort. Development of new products should no longer go along with obvious misrepresentation of facts.

Lester Berkowitz,
Nuclear Development Corp. of America,
White Plains, N. Y.

We agree. See p. 244, September MODERN PLASTICS.—*Ed.*

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If you have a packaging problem, or special packaging idea, Mack Molded plastics may be the solution. Mack technicians offer a 3-way service on product packaging, custom closures and merchandising sales aids. Mack will assist in the development of your idea, make recommendations on materials selection and collaborate on design. For help based-on-experience, just call or write outlining your problem.

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For more information write for Bulletin 129R

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Acrylic rides high in $2 million sign program

Acrylic is the chief material employed in a $2 million outdoor sign program of the Edsel Div. of Ford Motor Co.

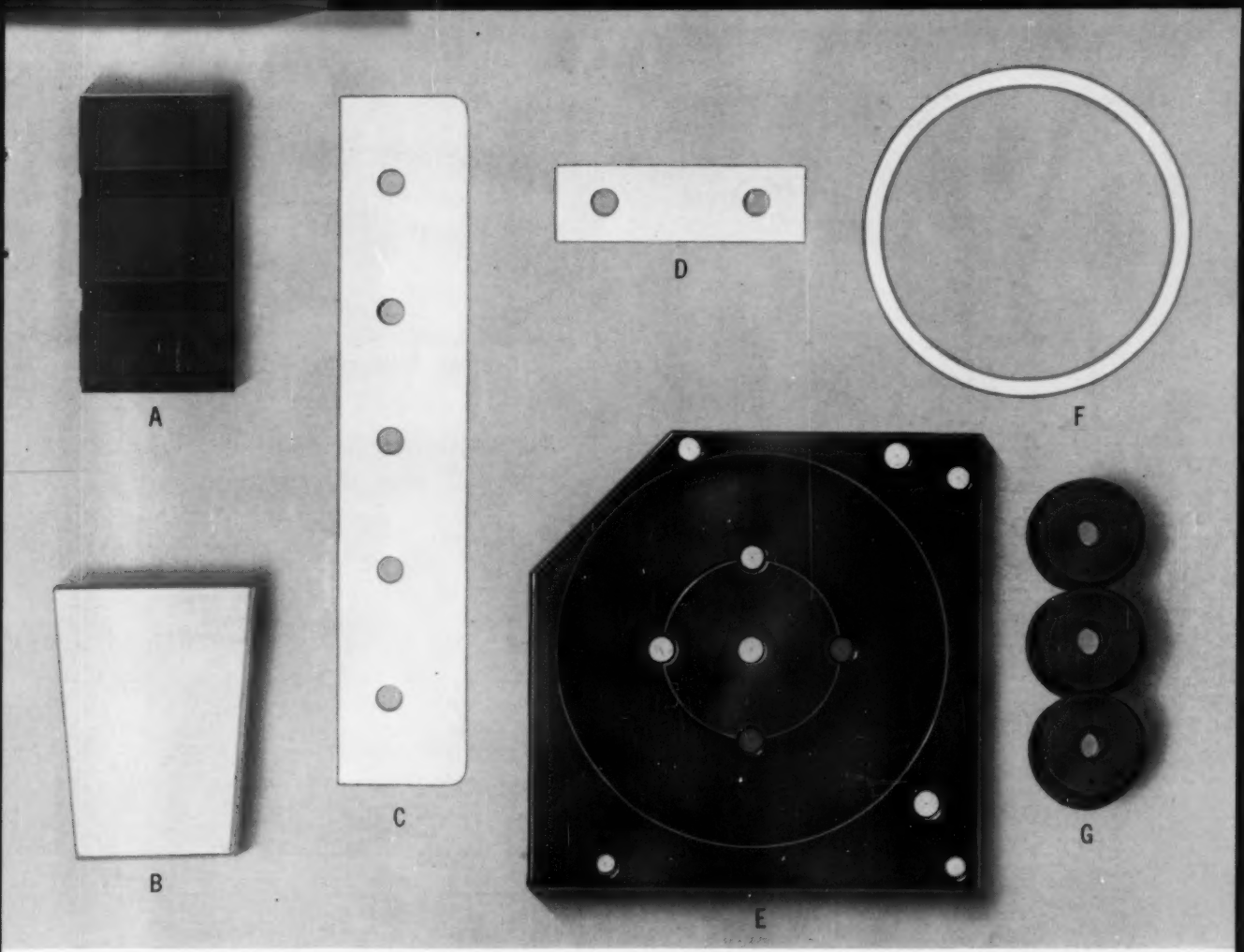
Described as the largest unified sign program in the history of the automotive industry, the signs are to identify dealers of Ford's new line of automobiles recently put on the market. There are to be more than 1250 dealers in all, throughout the 48 states. The main group of displays consists of acrylic-faced signs in stainless steel retainer frames, but the program also includes some porcelain displays. These are intended for dealers' showrooms and service facilities in the smaller population centers of the country.

The new acrylic signs, developed and manufactured by Federal Sign and Signal Corp., Chicago, Ill., are being readied for dealers as fast as they are officially appointed for the Edsel Division. Some 25 to 30 different types of displays in a variety of horizontal, vertical, and special styles are involved, but all of the acrylic signs will have the same basic design and the same color scheme—green and white. The green is a special color, "expressway green," developed especially for the Edsel sign by Rohm & Haas, supplier of the acrylic material. The green is used for both the background on a circle "E" emblem—the large "E" is white—and for the letters spelling Edsel on a white background. All the letters in the signs are produced by the thermoforming process.

The largest flat acrylic sheet being employed for the backgrounds is 17 by 30 ft., and 3/16 in. thick. The signs are lighted internally by means of slim fluorescent lamps.

Edsel's new sign program represents a new departure in the auto industry. It is the first time a major auto manufacturer's dealers have been able to intergrate dealer showroom signs so thoroughly into the nation-wide sales and marketing program developed for the cars. Previously, auto dealers have, for the most part, utilized varying styles, designs, colors and materials for showrooms and service facilities with virtually no national coordination.

Specifications of acrylic-faced signs being checked on assembly line. Project is the largest unified sign program in the history of the automotive industry; it includes a sign for every Edsel dealer and involves use of thermoformed acrylic and internal lighting on a major scale. (Photo, Federal Sign)



HOW MANY OF THESE PLASTIC PARTS CAN YOU IDENTIFY ?

We'll clue you, but we won't keep you guessing. All these are laminated plastic pieces used in industry, both as punched parts and as parts fabricated by milling, machining, drilling, etc. A description of each piece will be found below.

We make the saturating paper that goes into the laminated plastic material used in these and countless other industrial applications. We also supply saturating paper for decorative applications to the leaders in this field.

The entire facilities of our mill are now devoted to the making of saturating paper and other absorbent specialties. Inquiries are cordially invited.

KEY TO PHOTOS

A. Wire spacer; B. Golf club facer insert; C. Refrigerator door hinge shim; D. Insulation spacer for instrument; E. Rheostat cover for X-Ray equipment; (reduced in size), F. Hydraulic shock absorber gasket; G. Bushings used as spacers in aircraft industry.

THE WRENN PAPER COMPANY
Established 1858 **MIDDLETOWN, OHIO**

Nacromer®

makes any plastic look better... sell better

The visual impression your product makes is half the sale! And, Nacromer, the synthetic pearl concentrate, will give your product the appeal that increases sales. Here's how:

POLYETHYLENE

Nacromer completely overcomes the waxy, dull finish of polyethylene, providing a high gloss and transparency impossible to achieve any other way.

POLYSTYRENE

Nacromer endows this plastic with unequalled richness by creating a high pearly lustre of exceptional depth.

VINYL

Incorporated into this resin, Nacromer gives a smooth pearlized finish. Coated on embossed patterns, Nacromer adds sparkle.

ACRYLICS

Nacromer lends itself to pearlized patterns, swirls, and other unique effects in cast sheets and rods. In molded acrylics, it adds a distinctive pearly lustre.

ACETATE, CASEIN

Nacromer makes any plastic look better.

Compounded directly into the plastic, or applied as a surface coating, Nacromer adds eye-appeal. See the difference it can make in your product. Write today for complete details... please mention the plastic used.

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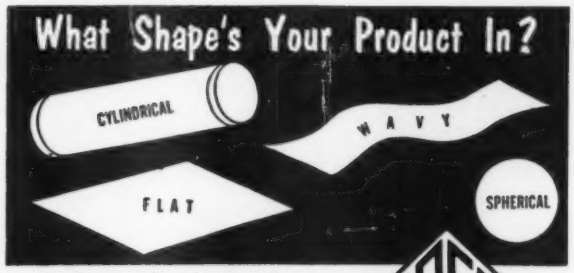
What Shape's Your Product In?



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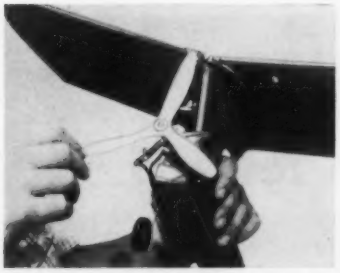


Model plane equipped with new nylon propeller. (Photo, Du Pont)

Nylon propellers

Propellers molded of nylon, now available to the model airplane builder, offer a long list of benefits. They are shatterproof and are reported to last more than ten times longer than conventional ones. Since the propeller is often the part of a model plane that strikes the ground first on the descent, it is one of the most critical parts, and a shatterproof propeller is a real boon to the model builder.

Besides being virtually unbreakable themselves, the nylon propellers minimize damage to the rest of the aircraft and the engine because of the shock-absorption quality of the nylon. Though the amount of fuel and type of model determine the length of flight, the new propellers also make possible more efficient use of engine power because they provide better thrust.

These propellers, the first to be mass-produced in nylon for model planes, are manufactured in a variety of sizes and blade pitches, and can be used with free-flight, radio-control, or control-line gas engine model planes. The propellers are injection molded on a 4 oz. machine in two to six cavity dies.

Price of the new molded propellers is about 50¢ retail for a three-blade model. While this is slightly higher than the cost of conventional propellers, the longer wear without fracture plus the other benefits more than makes up for the difference in price.

Credits: Propellers molded by Grish Bros., St. John., Ind. Zytel nylon resin supplied by Du Pont.

The hob (1) a replica in hard tool steel of the finished piece, is pressed into steel blanks to produce hobbed cavities (2) which are then machined (3) for insertion into a die shoe or mold frame.

CUT TOOL COSTS WITH

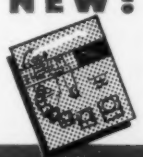
NEWARK DIE HOBBED CAVITIES

Die hobbing is often the key to lower tool costs. This process produces steel cavities with a minimum of machining, filing and polishing operations . . . and adds the insurance of maximum uniformity in multiple cavity molds or dies.

What's more, as the steel alternately flows and condenses under the hobbing pressure, the mold takes a closer surface grain structure that more faithfully reproduces detail in the finished product.

Now Producing cast cavities by the Shaw Process

NEW!



Write for your free copy of "How and When to Hob." Or let us discuss directly how Newark's complete die hobbing facilities and experience with all sizes and types of cavities may benefit you. No obligation, of course.

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More laminates from fewer hands

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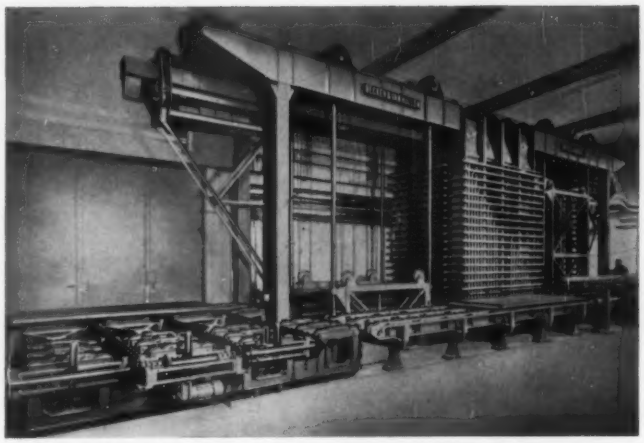

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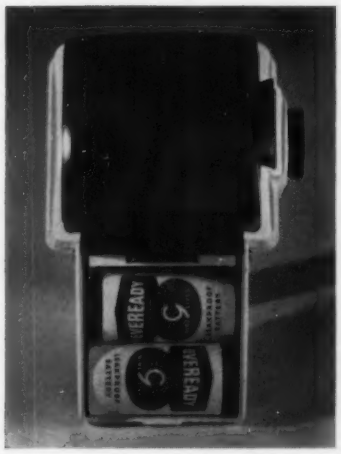


Styrene viewers

Two new picture viewers, with cases molded of impact styrene, offer focusing arrangements that give bright, magnified images which can be viewed simultaneously by more than one person. The impact styrene material gives the case of the viewers toughness, high gloss finish, and uniform color.

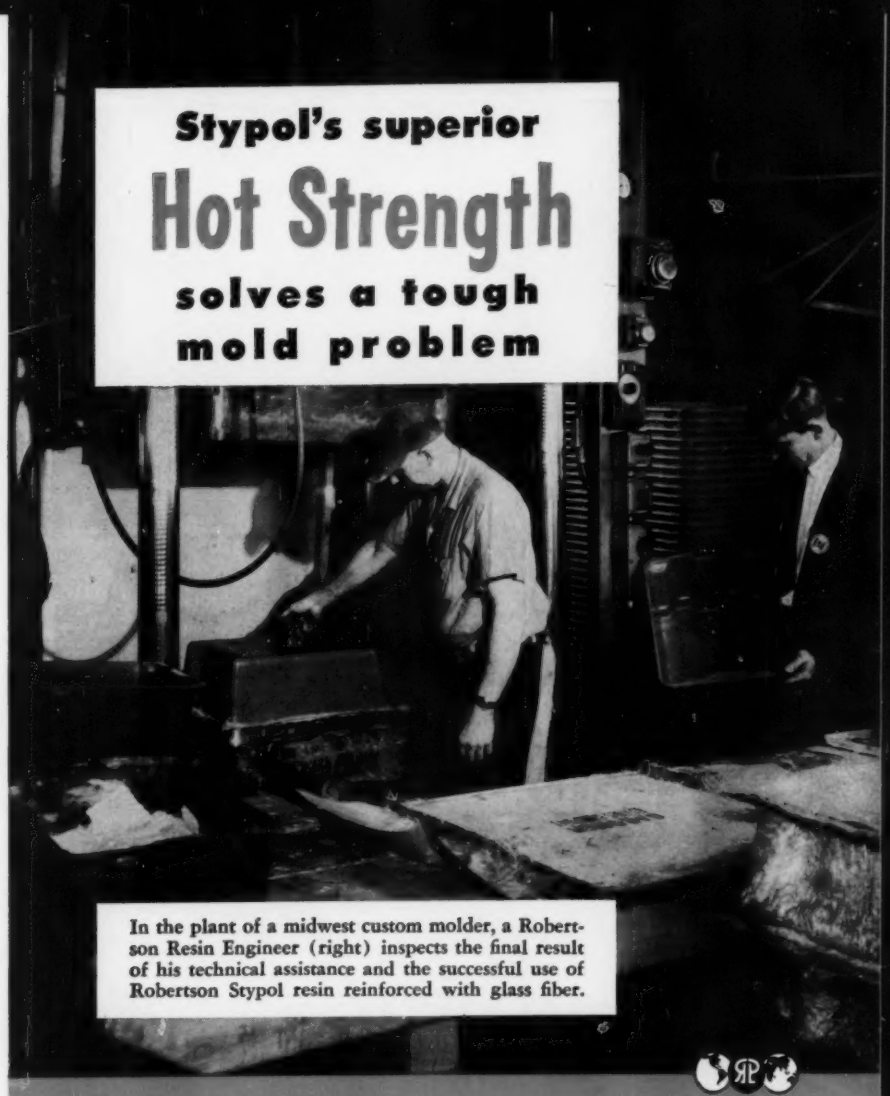
Designed for 2¼ in. square pictures (shown above and below) and 35 mm. slides (not shown). the viewers use four injection molded styrene parts: the main housing and battery case, focusing knob, lens mount, and a diffuser in front of the bulb. Powered by two size "C" batteries, and a flashlight bulb, the viewers snap open to give easy access to both batteries and bulb.

Credits: Molded of Bakelite impact styrene by J. & M. Zadiix Products Co., Brooklyn, N.Y.

Stypol's superior

Hot Strength

solves a tough mold problem



In the plant of a midwest custom molder, a Robertson Resin Engineer (right) inspects the final result of his technical assistance and the successful use of Robertson Stypol resin reinforced with glass fiber.

Robertson Stypols (polyesters) offer outstanding craze and blow resistance on short high temperature cure cycles plus far better than average hot strength and mold release properties, particularly in complex large moldings. One of the Stypols resists crazing in paint oven systems up to 260°F. In addition, these resins have an unusual ability to bury fibers so that the surface of molded parts is very smooth to the touch. Clip the coupon below and attach it to your letterhead if you would like a qualified Robertson engineer to work in your shop with you on your specific problem.

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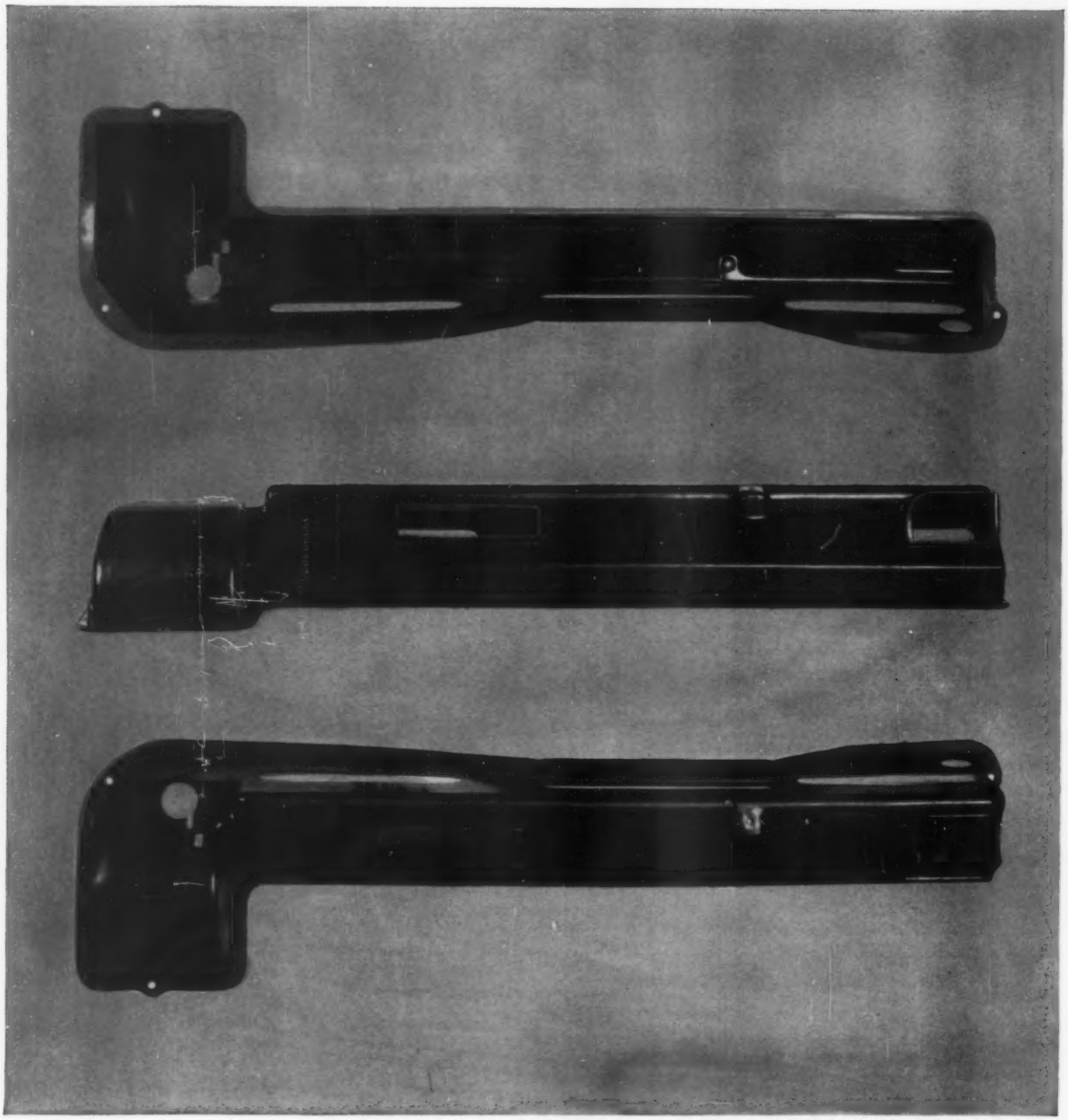

Heater housing, a premix molding by Woodall Industries, Inc., Detroit, Michigan.

Premix moldings save time, money and trouble

If your product calls for reinforced plastics, you'll save time, money and trouble with premix moldings. Small or large, simple or complex, you'll get quality molding faster and at less cost when resin and reinforcing fiber are blended beforehand.

Premix moldings eliminate resin-rich areas, provide uniform wall thicknesses and strength. They eliminate many finishing operations necessary in hand lay-up molding. Slots, grooves, holes, bosses and parts with varying wall thicknesses are formed in the mold. For strong, rigid, reinforced plastics, premix moldings have proved ideal . . . on the production line as well as in the finished product.

Polyester resin with Dow Vinyltoluene or Dow Styrene offers all the special properties necessary for successful premix moldings. Specify resins based on vinyltoluene—Dow supplies vinyltoluene to resin manufacturers. THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1888E.

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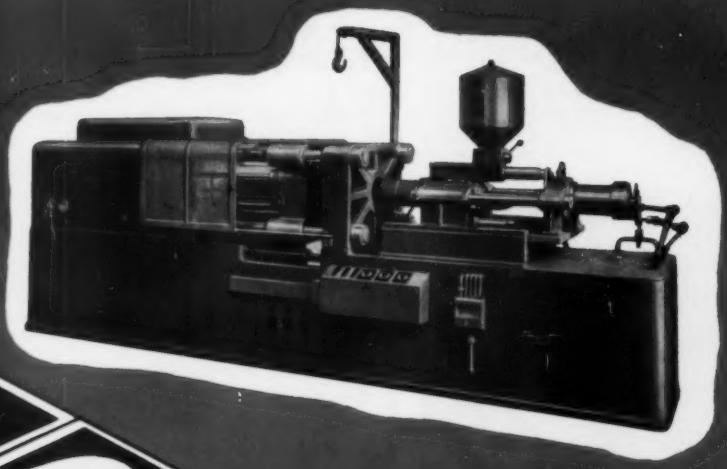

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Multiple Platen Press
for Rubber and Lamination
capacity: 62, 100, 200, 300, 600 tons

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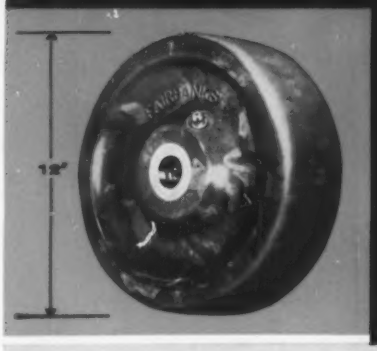

This is "Lamilon"—internationally-known "family" of nylon-reinforced all-plastic caster wheels in diameters from 3" to 12" made by The Fairbanks Company, New York 3, N. Y.

Mineral Filler Report: Fairbanks states M & C's ASP 400 Aluminum Silicate Pigment filler gives unmatched performance as follows:

a. ASP 400 provides "synergistic wetting and combining action" giving wheels a much higher heat distortion factor than nylon, resin or filler possess in themselves.

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Nose guard for jet

A new rigid PVC air scoop cover —a device that literally keeps the bugs out of jet fighter planes—has been adopted by the Columbus Div. of North American Aviation, Inc. The company is now using the one-piece cover on its FJ-4 Fury Jets while the planes are on the flight line awaiting delivery to the U.S. Navy.

Inserted into the open nose of the plane, the cover keeps insects, dirt, and debris out of the jet engines of fighter planes being serviced or quartered on the ground. The new nose plug is said to be more durable and less expensive than those made of wood.

The PVC covers are manufactured by vacuum-forming, with the covers and two handles shaped in a single operation. In size, the covers bear a close resemblance to the screen of a 24 in. television set.

In this application, the needed properties of PVC are physical toughness, relatively high-temperature distortion point, and good impact strength at low temperatures. All these qualities are important for the outdoor, cold-weather service the Jet nose plugs must provide.

Credits: Covers vacuum-formed by Westerville Industries, Westerville, Ohio, from Seilon PVC supplied by Seiberling Rubber Co., Akron, Ohio

Nose guard of vacuum formed rigid vinyl being installed by maintenance man in front end of Fury Jet. (Photo, Seiberling Rubber)

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POLYETHYLENE

Articles made of rigid, heat-resistant MARLEX 50 polyethylene can withstand temperatures from −180° to 250°F! Molded housewares are undamaged by boiling hot wash and rinse cycles in automatic dishwashers. Nursing bottles withstand live steam sterilization at 15 pounds per square inch steam pressure.

This new Sales Service Lab at the Phillips Research Center in Bartlesville is equipped with the latest plastics research and production equipment. Here, experienced engineers are developing data on new processing techniques and product applications, available to you through your local MARLEX sales representative.

New product applications for MARLEX 50 polyethylene include syringes, sterilizable pipe and fittings for chemical and food processing, pharmaceutical and food packaging that can be boiled or sterilized before filling, infants' toys, and many more yet to come. MARLEX 50 is odorless . . . nontoxic . . . and highly impermeable.

Bandages, swabs and instruments sealed in tough MARLEX 50 film can be autoclave sterilized without removal from packages. MARLEX 50 is also ideal for molded hospital items that must be sterilized repeatedly . . . such as vials, bottles, tumblers, pitchers, emesis basins, funnels, beakers, bedpans, urinals, trays.

*MARLEX is a trademark for Phillips family of olefin polymers.

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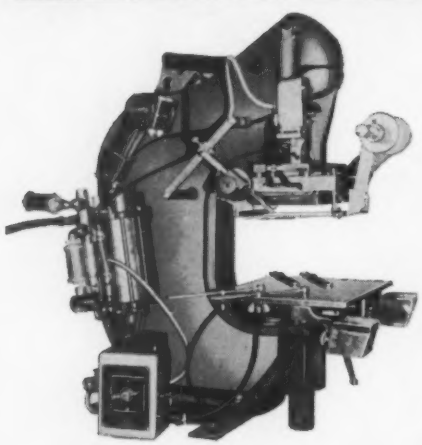

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- Standard head sizes of 6" x 9" or 8" x 12". Special heads have been made up to 24" wide to mark refrigerator parts, etc.

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- Roll leaf color chart showing complete line of Olsen Mark Leaf will also be sent.

Specialists in Quality Marking Equipment and Supplies for over 30 years

Pipe insignia

Members of the Plastic Pipe Research Council of the S.P.I. have adopted a new insignia to identify plastic pipe approved for the transmission of drinking water. The insignia may be used by raw materials suppliers and pipe manufacturers whose products meet the standards which have been set up by the National Sanitation Foundation.

The new insignia, besides its use for labeling pipe, can also be displayed in advertisements, publicity material, point of purchase display pieces, letterheads, packages, etc. In addition to the S.P.I. insignia, the 37 member firms of the pipe council may use the Seal of Approval of the National Sanitation Foundation.

Member companies of the S.P.I. group are: American Hard Rubber Co. Div., Amerace Corp.; American Plastic Pipe Corp.; Anesite Co.; Bakelite Co. Div., Union Carbide Corp.; Busada Mfg. Co.; Carlon Products Corp.; Chesflex Corp.; Crane Co.; Crescent Plastics, Inc.

Dow Chemical Co.; E. I. du Pont de Nemours & Co., Inc.; Eastman Chemicals Products, Inc.; Easton Plastic Products Co., Inc.; Electric Hose & Rubber Co.

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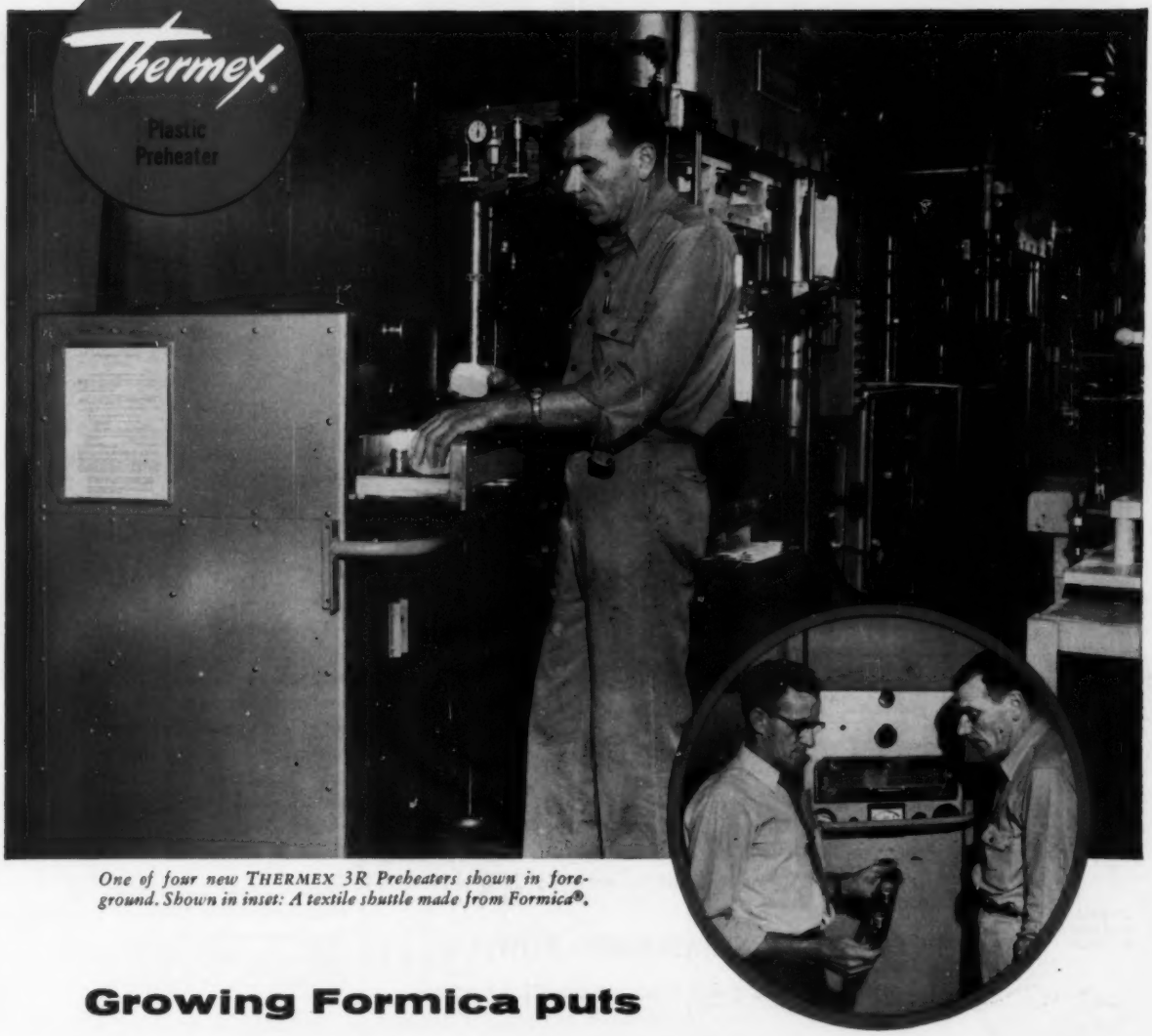
Plastex Co.; Pyramid Industries Inc.; Republic Steel Corp.; Sloane Mfg. Co.; Southwestern Plastic Pipe Co.; Spencer Chemical Co.; Triangle Conduit and Cable Co.; Western Plastics Corp.; Yardley Plastics Co., and Colonial Plastics Co.



One of four new THERMEX 3R Preheaters shown in foreground. Shown in inset: A textile shuttle made from Formica®.

Growing Formica puts

4 more THERMEX Preheaters on 24-hr. duty

PROGRESSIVE FORMICA CORPORATION, Cincinnati, has recently added four new THERMEX* "3R" Preheaters, bringing their total installation to eight THERMEX units.

Formica estimates that their first four THERMEX units, which have served dependably for about 8 years, give uniform preheating at rates many times faster than the former method. They are expecting their new THERMEX units to serve on a round-the-clock schedule with the same reliability.

Have a THERMEX Engineer study your molding operations to suggest possible ways to cut costs with THERMEX Preheaters. Bulletin T95R4 describes the new Model 3RB unit. Free on request.

*Thermex—T. M. Reg. U. S. Pat. Off.

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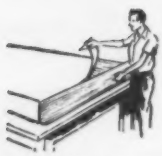

As a molding liner for polyurethane foam, Patapar does not "pit" the surface.

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Acrylic for lather

A feed screw machined from cast acrylic rod has reduced the weight and improved the balance of a new electric lathering machine for barber shops. As an additional benefit, the plastic part never requires lubrication.

The lathering device delivers warm, fresh lather for shaving at the touch of a button. The machine holds a liquid supply of soap. When the button is pressed, a charge of the soap is forced into one end of the worm drive screw. The acrylic part aerates and agitates the mixture as it turns, and converts it into lather at the other end. A heating element inside the screw shaft heats the lather to between 95 and 105° F.

The acrylic screw in this application replaces a heat-treated aluminum part, at a weight saving of about 60 percent. The plastic is impervious to the very hard water, solid soap solutions, and free potash which the lathering machine is likely to encounter in service. There is no cost premium: because of the ease of machining and balancing the cast acrylic part, it can be produced at a cost no higher than that of the finished aluminum unit.

Credits: Junior LatherKing manufactured by Campbell Products Co., Bensenville, Ill. Cast acrylic rod supplied by Cadillac Plastic & Chemical Co., Detroit, Mich.

Worm gear, machined from cast acrylic rod, delivers warm, fresh foam in new barber's electric lathering device

"When we switched to SUPER DYLAN® polyethylene, plastic pail sales jumped 100% in 30 days!"

. . . says Jerry B. Mockenhaupt, Sales Manager, Victory Mfg. Corp., Chicago, Ill.

MID-YEAR 1956, Victory Manufacturing introduced a new line of plastic household mop pails called the "Lo-Boy." They were designed to stand 7½ inches high with a 12¾-inch-wide mouth to accommodate modern sponge-mops. One simple factor seemed to hinder the sales of this otherwise extremely practical item. When the pail, carrying its usual 12 quarts of water, was lifted, the sides spread somewhat, making it possible for water to spill over. To eliminate such a possibility, a new material was sought.

A Switch to SUPER DYLAN

Mr. Sidney Spivak, nationally known raw materials authority with Victory, directed the testing of many base materials—SUPER DYLAN among them. Dimensional stability and structural strength were *musts*. In addition, the material used had to pass corrosion tests using household detergents as well as 100% acid solutions. SUPER DYLAN was tested and chosen.

Attractive and easily handled

Today the "Lo-Boy" pail is a really big seller. Molded in several colors, the buckets are easy to handle—slip under low-slung modern spigots, retain their shape—never spill on the carrier and won't dent, chip, mar or discolor.

Koppers plastics are going into new products almost daily. Perhaps one of our plastics can improve existing products or make new products possible for you. For more information on DYLAN® polyethylene, DYLITE® expandable polystyrene, DYLENE® polystyrene or SUPER DYLAN polyethylene, write Dept. MP-107, Chemical Division, Koppers Company, Inc., Pittsburgh 19, Pa.

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ON THE PRODUCTION LINE For supervisory checking of production tinting against laboratory formula the "Lablite" (Model BBX 526) will give you the standardized lighting quality you need, at low cost. Effective working area 375 square inches, 1000 watts.

The C-40 Examolite fixture, a blend of color-corrected fluorescent and incandescent lamps, is also recommended for production personnel.

THE FINAL CHECK Against lab sample and customers sample should be made back in the lab under the BBX 826.

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World trade

(*From pp.* 101-109)

to Germany and Italy. This phenomenon also appears to be the cause for Great Britain's declining share in total world exports as outlined in Table II. Within the Commonwealth market, of course, the British command a secure position except for Canada, where proximity and American investment in the industry make the United States the overwhelming supplier. The Union of South Africa, India, and Australia are by far the largest customers in this market which strongly favors Great Britain through preferential tariffs and foreign exchange restrictions. Australia, for example, receives her resin imports (see Table IV, p. 103) almost exclusively from Britain.

Similar to West Germany, British vinyl exports occupy a predominant position with over one fifth of total exports. Unlike any other country, urea formaldehyde resins follow in second place; however, only one third of it is exported in the form of molding powders. A great deal of urea resins is going to Europe, where British producers find comparatively little competition in that particular resin group. Polystyrene is a poor third; exports have been slow due to sharp American, Canadian, and Italian competition. Considerably cheaper Canadian and Italian imports caused part of the British polystyrene capacity to stand idle in the last two years. Polyethylene exports are believed to be substantial, while specialty resin exports are still very small.

British imports were sharply cut during 1956. Vinyl imports, nevertheless, remained the largest category ever, chiefly because the Bakelite plant was out of commission for a time. Reports indicate that domestic vinyl market conditions have been aggravated by the arrival of considerable quantities from Italy, Canada, and the United States, with prices well below those quoted by British producers. As indicated above, like conditions exist with regard to polystyrene. By far the largest source of all these imports is the United States (1956: 45%), but German sales to Great Britain become more important every year (1956: 27%).

Italy

Although the smallest of the big four net exporting countries,[3] Italy is a striking example of growth in international plastics trade. In 1950 exports were practically nil; in 1956 her share of total world trade reached 8.5%. Since 1954 her exports even exceeded her imports. With a limited domestic market the industry has to divert increasing proportions of the rapidly expanding output to foreign sales. This ratio of exports to production has been rising quickly and as a consequence the industry has become highly susceptible to international market conditions. Italian exports as percentage of production have run: 1951: 6.8; 1952: 12.3; 1953: 15.0; 1954: 24.6; 1955: 48.4.

Apart from quality, the success of Italian plastics in world markets is mainly attributed to low prices, especially for PVC. The reasons for these low prices are primarily: low labor cost; somewhat lower electric power cost than Germany and Great Britain; well-integrated, well-controlled industry set-up; export dependence of industry.

By far the largest exports are in the form of PVC, followed by polystyrene and polyethylene: together they make up 90% of all exports. Germany, Switzerland, Great Britain, Canada, and the United States are the main customers. France and the surrounding Mediterranean countries (Spain, Portugal, Greece, Egypt, Israel) also buy substantially.

Imports are small and carefully limited to newer resins or qualities not available domestically.

Canada

Polystyrene is the essence of Canadian plastics exports; in 1955 it amounted to 65.4% of total plastics exports. Great Britain, Hong Kong, Germany, France and the Netherlands are the best customers, while the United States, predominant supplier of plastics raw materials for Canada, buys only very limited quantities;

[3] Exports of these countries exceed imports.

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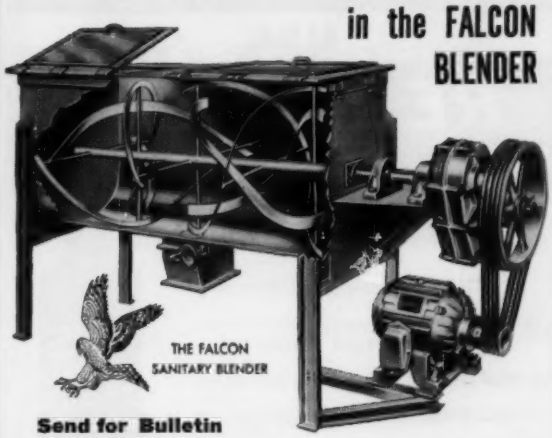

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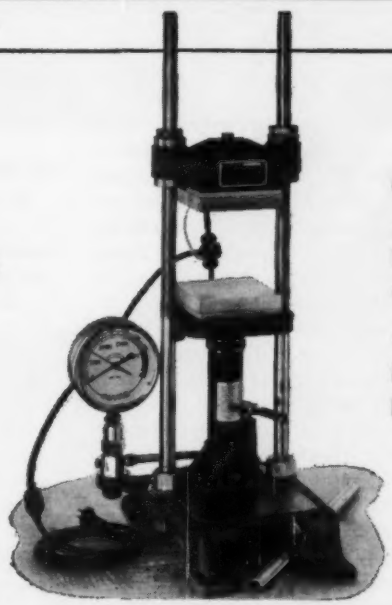

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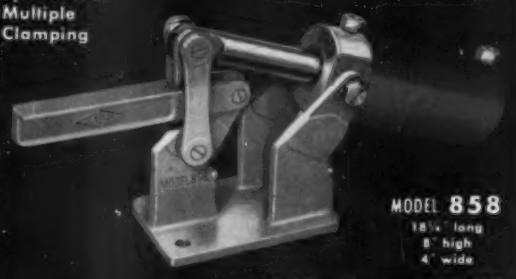

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Canadian producers claim that U. S. tariffs are too high and Canadian tariffs too low.

France

Until 1954 French production and exports of plastics had been quite static. Since then the sudden availability of hydroelectric power and the rapidly-starting petrochemicals industry caused recent expansions and made the industry practically independent with regard to most of the basic components for plastics raw materials. Nevertheless, imports still exceed exports by two to one.

PVC, polystyrene, and polyamides, constituting the bulk of exports, were sold to Switzerland, Argentina, the Benelux, and French Overseas Territories. Rather interesting is the appearance of Red China as a recent customer, ranking in seventh place according to volume of sales.

Japan

Among the rest of the exporting countries Japan has the greatest future potential. Based on coal and carbide, the country first built up vinyls, ureas, and phenolics. Today it has sufficient capacity to fulfill not only domestic, but also some export requirements. The vinyl situation is not quite clear, because Japanese export statistics are not sufficiently subclassified. On one hand Japan exported vinyl plastics, but, on the other, the country also received substantial quantities of vinyl plastics. The question of "what specific materials" remains unanswered. However, since the country has export capacity, it is not surprising that she looks with great interest upon trade with Red China, where PVC especially is in great demand.

Up till now Japan has been importing large quantities of polystyrene and polyethylene. Recent plant announcements and foreign exchange shortages will soon reverse this trend. The Five Year Plan of the Japanese Ministry of Commerce shows that exports of these materials may start within two years. There is little doubt today that, apart from specialty resins, Japan will soon be a major competitor in such Far Eastern areas as the Philippines, China, and India.

Changing world trade pattern

The export and import analysis of various countries raises the question whether there is a definite market pattern. Unfortunately no clear-cut answer can be given. Very often exports and imports change considerably upon the need and availability of specialized materials. Subsidiary companies abroad often buy large quantities until their plants start operating, when imports suddenly drop. Shortages and emergencies also influence the market temporarily. Aside from such factors, which seem to prevail especially in the more developed countries, there is probably a basic market pattern which is presently undergoing considerable changes. The rise of Germany, Italy, and Scandinavia has changed the market position of Great Britain and the United States. Great Britain is becoming more dependent upon

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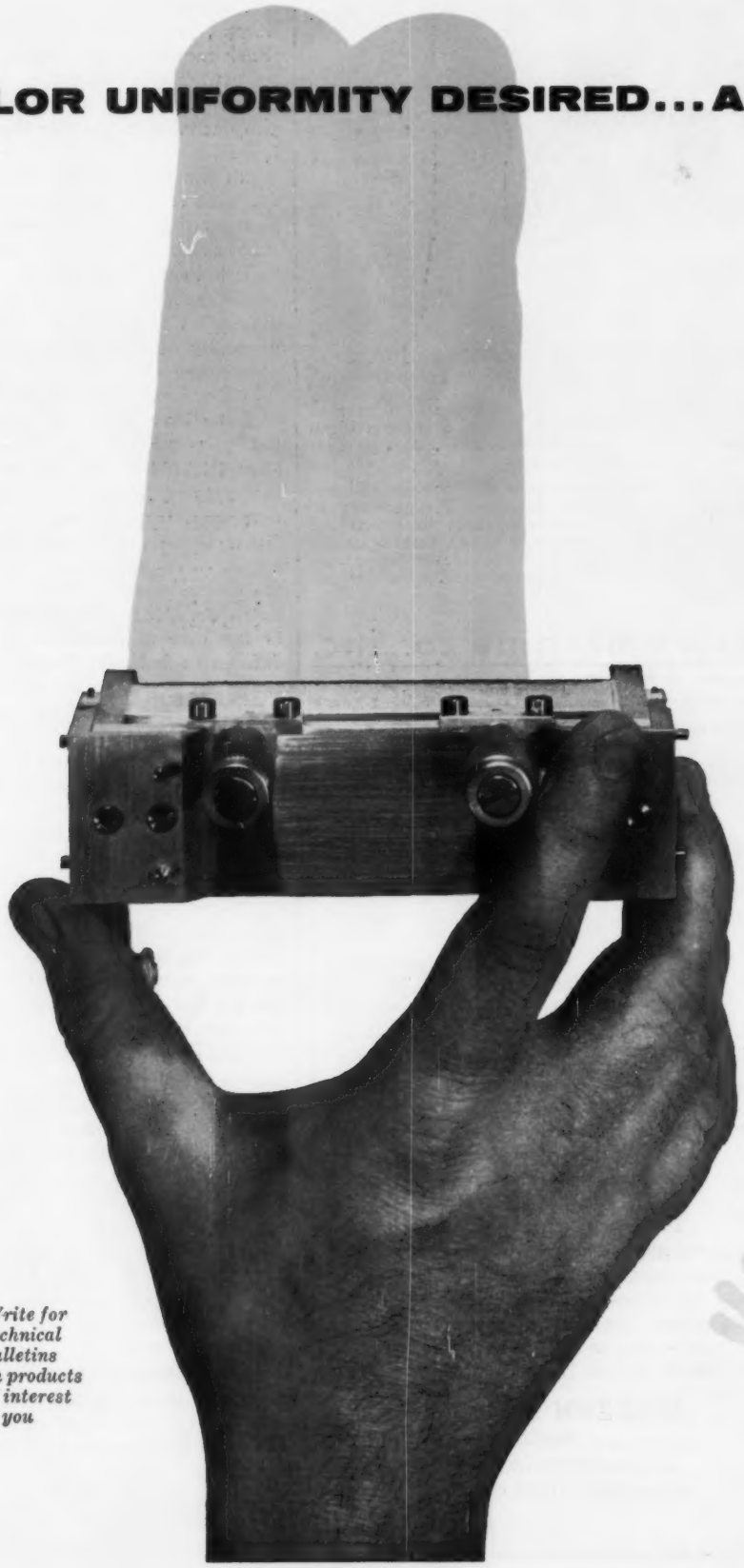

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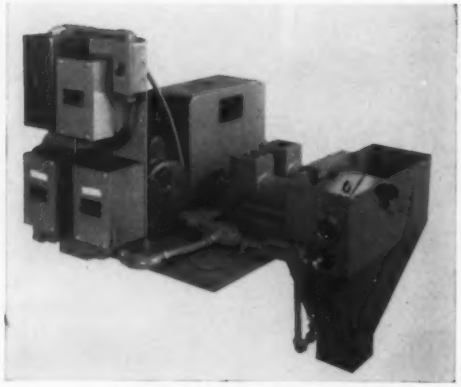

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her Commonwealth market; she still exports large quantities to Europe, especially of products which meet limited international competition—for example, urea resins. The European market is also declining in relative importance for the United States, as South America, Canada, and the Far East receive increasing proportions of American exports.

Several broad economic factors have influenced this trend:

1) Proximity: With decreasing differences in quality and prices proximity becomes an important competitive advantage.

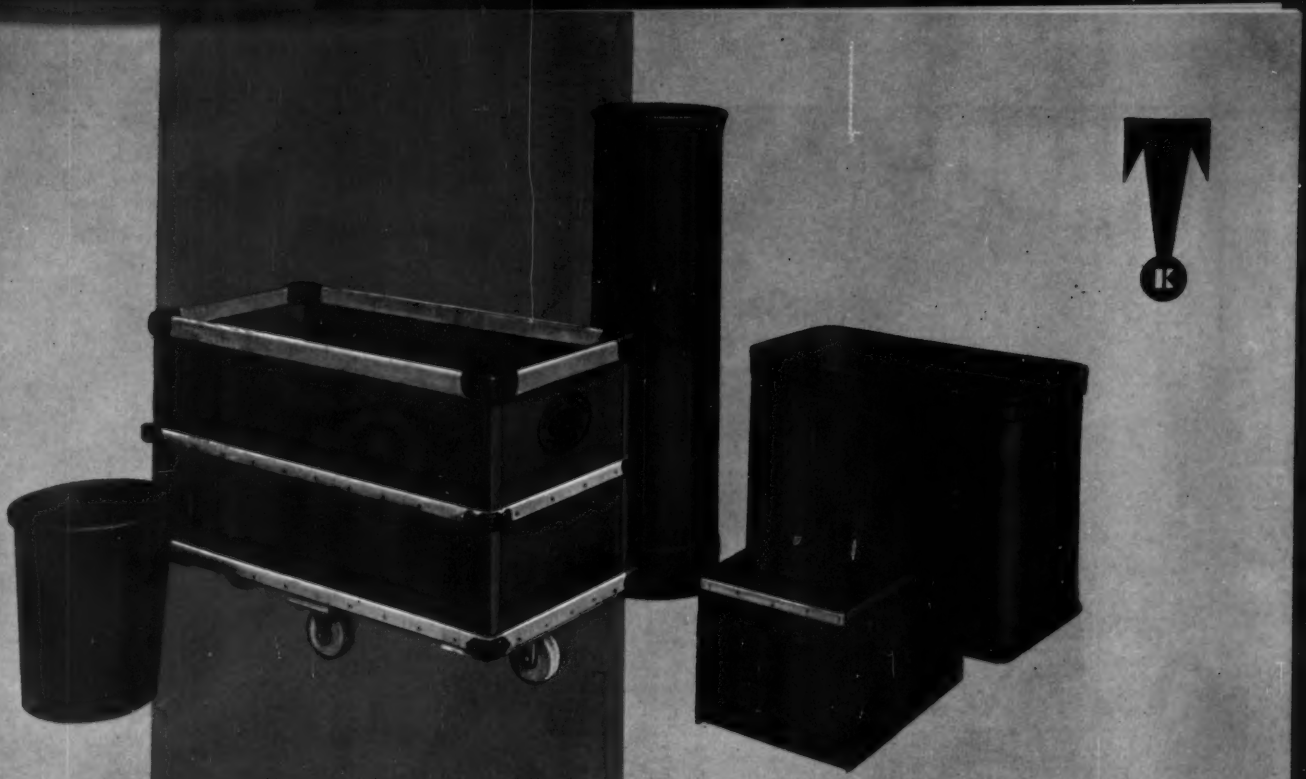
2) Preferential tariffs: In general the Free World adheres to the principle of unconditional Most-Favored-Nation treatment; that is to say, equal tariffs apply to all imports regardless of origin. Great Britain, however, enjoys major tariff advantages within the Commonwealth. These lower tariffs are often very decisive, as in the case of Australia where differences between preferential tariffs on British plastics materials and materials from other countries run between 12½ and 15 percent. Australia, as a partial consequence, obtains her plastics raw materials imports almost exclusively from Great Britain—a most distant source.

3) Discrimination through foreign exchange and/or import license: Due to the scarcity of dollars in the world, American exports of plastics raw materials are often in the position of being discriminated against.

In the sterling area, foreign exchange regulations require all area members to obtain materials preferably from other member countries: principally from Great Britain; secondly, from soft currency countries such as Italy, Germany, etc.; and finally from the dollar area. Dollar exchange licenses are only granted when the importer can prove that the material is not available within the sterling area.

As members of the European Payments Union, Germany, Italy, and Great Britain enjoy an extra added advantage over the United States.

Finally, in many dollar-shortage countries, import quotas or special import licenses handicap



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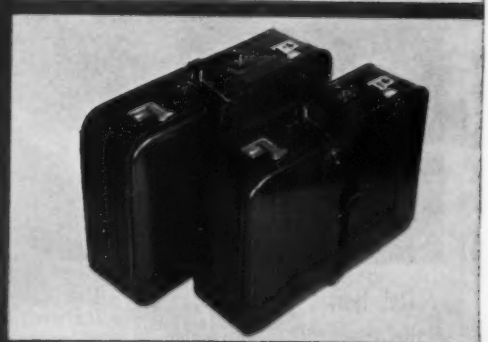

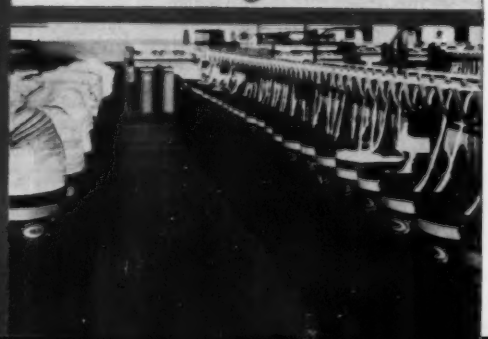

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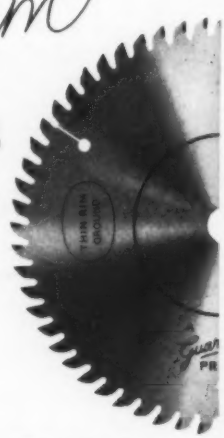

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American exports. At present the following countries have such provisions in varied form: Argentina, Brazil, Chile, Hong Kong, India, Portugal, Spain, and Uruguay.

Licensing and participation abroad

Aside from the above-mentioned factors, actual exports of plastics raw materials are profoundly influenced by licensing agreements and foreign participation.

Absolute figures of world trade in plastics raw materials have constantly risen, but world trade as a percentage of world production has been declining. Before World War II exports were roughly 20 to 25% of production; in 1950 the same figure was around 15% and today it is down to almost 10 percent.

This decline is primarily due to the expansion of "invisible exports" in the form of licensing agreements and investments abroad. First, it is a convenient and often financially attractive way of exporting indirectly. Second, it pays in many cases to take advantage of lower foreign production costs. Third, economic development and growing national sentiment have raised tariff barriers in many places to a point where it becomes necessary to "jump" those obstacles in order to reach the market. Furthermore, plastics themselves can fit into the economies of any country in the world. Even under-developed nations can use plastics articles immediately. Wherever plastics molding and fabrication has been started, there is also a stimulus to produce locally the raw-materials required for these operations.

Local production through licenses as well as foreign investment has been most extensive in the three large resin groups: vinyls, polystyrene, and polyethylene. The world maps and listings on pages 104 to 108 give a complete production picture for these three main product groups all over the world. The maps are confined only to plant facilities and do not include such intangibles as licensing agreements. Where plants are owned jointly, Ameri-

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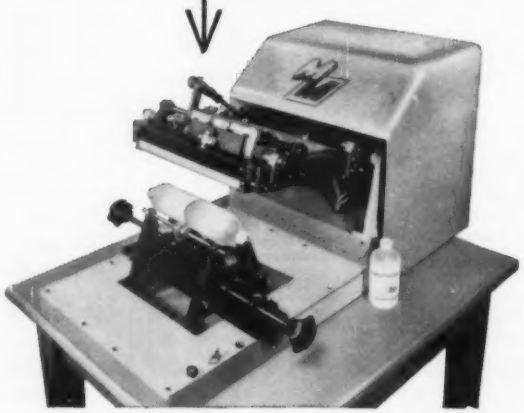

can ownership is only shown when it is equal to or greater than 25 percent.

United States—future

The maps bring to attention the strong American participation in the plastics industries of foreign countries, most of which originated in the last few years. For example, last year American companies established plant operations in such diverse locations as Japan, Mexico, Brazil, Australia, and India.

In the developed countries, especially in Europe, United States producers find process and technical know-how licensing convenient and profitable. Today plastics producers in literally all European countries produce some kind of plastics under American license. At the same time intra-European as well as European licenses in the United States are also numerous. Licenses were exchanged even in the early '30's, but a wave of agreements started in the '50's, with polyethylene, polyurethanes, vinyl foams, epoxies, and other recent resins leading the way. Available skill in Europe, convenience of method, proved profitability, and perfection of contracts indicate further steps in this direction, provided American companies maintain their leadership in fundamental research as well as in technological improvements. In this connection Germany has come back very fast as indicated by the development of low-pressure polyethylene, polyurethanes, and the very recent polycarbonates. Complacency under those circumstances would be a fatal mistake.

Despite foreign operations and licensing, exports will probably continue to increase. However, the future seems to differ considerably for different resin groups. Vinyls and to a lesser degree polystyrene exports appear to have reached upper limits and may even shrink soon. Cellulosics and amino resins will probably continue to fluctuate around the present level.

Exports of the newer resins, together with foreign operations and licensing, are the key to the future plastics business of the United States abroad.—END

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the best machine for all materials

THREE THOUSAND of these machines are in constant use because they do a better job of grinding, are easier to clean, sturdier, and are preferred by the personnel who operate them.

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Floor Space: 25" x 20½"
Height: 46"
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Floor Space: 34¼" x 30"
Height: 60½"
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MODEL 3X 5 HP
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Two 5 HP motors
Floor Space: 42½" x 30"
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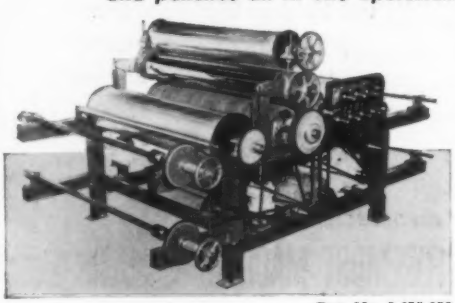

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Housewares

From pp. 110-112

become partial to the feel and appearance of conventional polyethylene. These molders didn't mention the 10¢ or so per pound price differential—they may sing a different song when and if that differential diminishes.

However, there were several unique applications which can take special advantage of linear polyethylene's properties. One was a fly swatter; the extra stiffness of the material is especially effective. Another was a grass rake which was once in butyrate —again, extra stiffness and flexibility at low temperature were desirable.

But the most noticeable display of linear polyethylene was a brand new line of bowls and vacuum formed lids for buckets and waste baskets. Extra stiffness was the emphasized property of both applications, together with extra fine surface and color. More resistance to grease or oil and the fact that boiling water can be poured into the bowls without harm was also claimed for these products.

This small beginning of linear or high-density polyethylene exhibits at the show was more than offset by the huge displays of low-density or conventional polyethylene applications. A good many housewares molders exhibited nothing but polyethylene pieces at the show.

Two years ago there were only a few molders whose polyethylene items outnumbered other plastics items.

Buckets

Outstanding was the number of buckets exhibited. There seems to be a real revolution in buckets and most startling is the variety in design. Wooden and metal buckets are just about the same today as they were hundreds of years ago, except for upgraded versions of the old oaken bucket; on the other hand, polyethylene buckets in evidence at the show, represent an entirely new breed, with features altogether foreign to their conventional predecessors.

They have feet, a variety of

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THE START – product design, engineering of molds and assembly equipment, material choice, and color selection.

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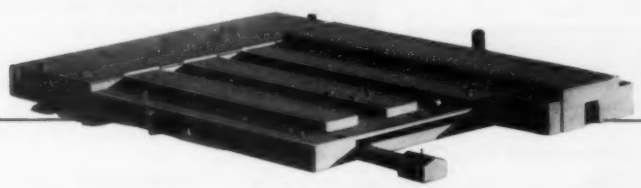

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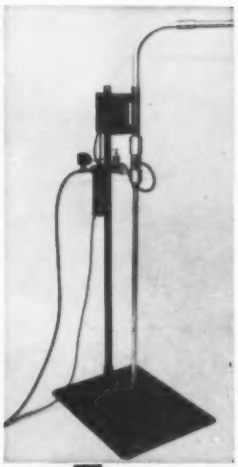

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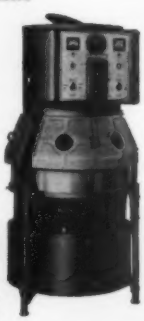

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fancy spouts, appendages to aid pouring and holding, fancy handles—some even contain a special insert for a scrub rag—and various other apurtanances. They may be rectangular or square. Every molder in the business seems to be striving to find a new gimmick for a bucket. The amount of money tied up at the present time in bucket molds defies the imagination.

Two other big items which are starting a revolution are clothes baskets and dish pans. After seeing the new rectangular shapes which save space and fit snugly into a sink, one wonders why a woman would ever buy a round or oval one.

One producer of big garbage cans reports that sales of his huge containers are mounting nicely. It has the added feature of a built-in sterilizer and deodorant, which will not only appeal to home owners but will also be hailed by employees of municipal sanitation departments.

Still another item that is probably molded by the million is juice containers; every molder uses a different design. There are now screwed-on tops and various spout designs that prevent dripping and they can be used for such purposes as mixing pancake batter as well as holding fruit juice.

Another rapidly growing use for polyethylene is in extruded cord-like supports which serve as springs or takes on summer furniture. A chaise lounge so equipped costs approximately $50—a chair sells for about $25.

An all-polyethylene molded toilet bowl brush was shown with molded-in fingers or stubs in place of bristles; the same molder exhibited a lace-work shopping basket in which colored ribbon can be intertwined for decorative purposes.

Polyethylene bottles were also shown by two new bottle makers. One is shaped something like a hand grenade, with molded-in corrugations which permit an easy grasp.

Polystyrene

Polystyrene has, of course, suffered from the invasion of polyethylene but is by no means a

dead duck in the housewares field. For example, thin, clear polystyrene tumblers decorated with tasteful, brilliant, printed coloring were exhibited; it was stated that 2 million a month have been sold since last January. Another line of impact styrene tumblers that appear to be almost as flexible and just as strong as polyethylene had a beauty that can hardly be matched. An impact styrene salad bowl and individual dishes on display compare favorably with stoneware in appearance. Impact styrene refrigerator bowls were being enthusiastically merchandised, with emphasis on the point that they can be used with electrical food mixers without danger of collapse.

Flower pots and rectangular containers for plants in polystyrene are still going strong. Styrene lids of polyethylene containers are still popular and such things as canisters, refrigerator containers, and the old lines of kitchen equipment are by no means dead. Price and color keep up the demand. Impact styrene handles for kitchen tools are far more prominent than they were two years ago.

Probably the standout in polystyrene was housings for clocks, especially in a new "snooze-alarm" clock which rings intermittently after the first blast. One transistor radio was offered with an impact styrene housing—the others still rely on general-purpose material.

A highly favored novelty at the show were vacuum formed wall plaques in fine sculptured patterns, produced from wood grain and metallic colored impact styrene sheet. They are being produced at a rate of 1200 to 1500 a day and over half a million have been sold to chain stores. They retail at 98¢ to $2.98 each.

Still another use for impact styrene is in storage cabinets for small items, each of which contains a number of small plastic drawers. Impact styrene is now being used in the side walls to replace metal.

Vinyl

Large quantities of vinyl chloride items were exhibited at the show but not in much varia-

Let these
TALENTED TWINS
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PLASTOFLEX ESO and PLASTOFLEX EET . . . two new ADVANCE products with a single thought – to help you impart heat stability – improve the performance of both the stabilizer and the conventional plasticizer . . . all at very reasonable cost.

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Epoxidized soya type plasticizer – low migration and extrability, with high epoxy content. Prevents any sudden degradation of the vinyl compound which employs zinc in the stabilizing system . . . improves stability. Recommended for vinyl foam, coated and calendered sheeting, garden hose, floor tile – and in Plastisols and Organosols (in which it imparts excellent viscosity).

PLASTOFLEX EET

Ester type epoxy plasticizer . . . extreme low temperature flexibility . . . efficient stabilizing action . . . imparts excellent color stability to vinyl compound . . . prevents any sudden degradation of the vinyl compound which employs zinc in the stabilizing system. Recommended for garden hose, film and sheeting for use at low temperature, slush molding compound, jacket and insulation stocks.

May we send you samples and data sheets?

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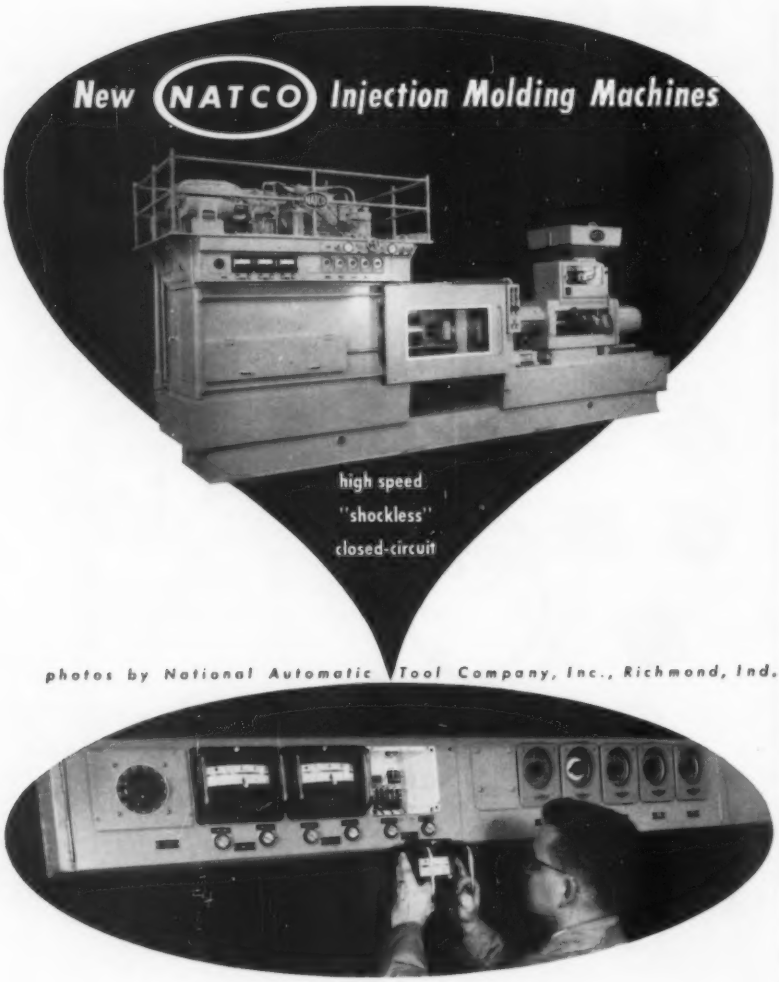

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the trend is to **WEST**

tion from two years ago. There are now four major producers of adhesive-backed vinyl-coated paper which is applied largely by the do-it-yourselfer. This material is being suggested largely for decorative purposes on chests, canisters, shelving, boxes, and the like. Vinyl-coated paper without the adhesive backing is also being merchandised for the same uses. This product is attached to the surfaces by thumb tacks or other conventional means.

Table cloths in both vinyl-cloth laminates and coated fabric are now much more competitive with each other than formerly; the coated-fabric advocates claim their material will stand more flexing.

Shower curtains are being made in thicknesses of from 3 to 7½ mils and sell at prices from $2 to $6.95 or higher. Design and quality continue to improve, but competition from other materials is getting stronger, mostly in the high price lines. Sales were increased three-fold on one line as a result of packaging the merchandise in a vinyl-covered box that could be re-used for storage of facial tissues.

Cellulose-stuffed shelf covering with a quilted vinyl top is also a popular novelty. Attractive use is being made of textured tweed and satin-finish 12-mil vinyl for covering hassocks that can be stacked when not in use and chest hassocks that can be used for toy storage, etc.

Hampers are now largely coated with pearlized or quilted vinyl and lined with vinyl film. Vinyl-covered picnic kits were shown all over the place.

In addition, there were various other vinyl items to emphasize the material's utility, such as coated wire kitchen baskets, vinyl-coated glass bottles for cosmetics, and especially attractive kitchen tool handles dip-coated with vinyl plastisol.

There were many other plastics items on exhibit. It would be almost impossible to give a complete list, but anyone who is seriously interested in selling plastics would be foolish indeed to pass up an opportunity to see what goes on at the housewares show.—END

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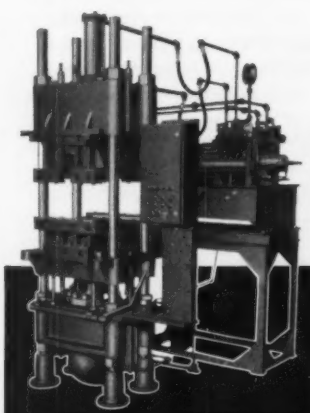

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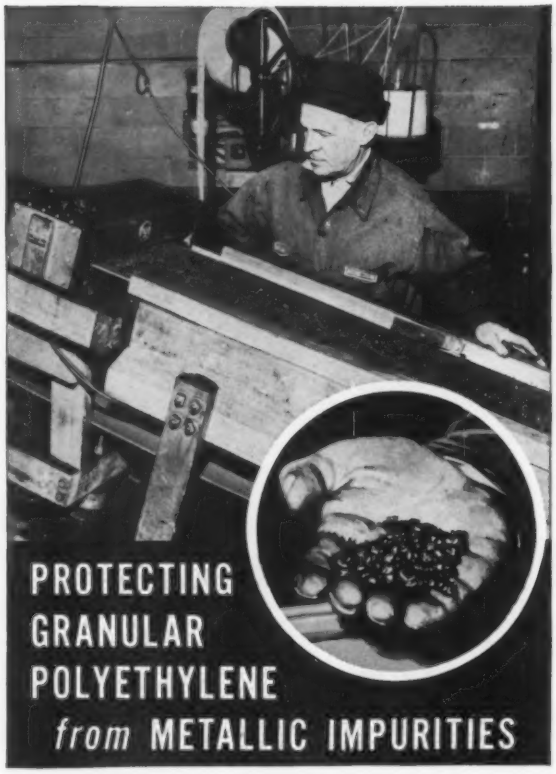

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British Show

(*From* p. 113)

materials, notably in the styrene acrylonitrile and acrylonitrile butadiene types. The great deal of activity noticed recently among U.K. producers of styrene sheet was demonstrated by the number of exhibits in this material. Among new types of sheet were printed high-impact types, and a special opal light-stabilized material for lighting uses. Interesting new applications in the polystyrene field were shoe-heels; a form of terrazzo flooring produced by embedding polystyrene molding crystal in the concrete base; extruded tubing for breweries; vacuum formed sheets for concrete shuttering. Disposable cups injection molded and vacuum formed were featured.

Types of nylon

Although there was nothing new in the nylon field, it was instructive to be able to compare the various types of nylon produced in Europe. They included the U.K. types 6/6 and 6/10 based on adipic acid, caprolactam (Nylon 6) made in Holland, and Switzerland, and Nylon 11 made in France and derived from 11-amino undecanoic acid. Examples of most processing techniques from these materials included centrifugal casting and extrusion molding. Among notable products were a bicycle saddle, cutlery handles, and a fish transport box all injection molded.

A few developments were noted in the cellulosic field, including the possibility that cellulose propionate may be manufactured in the U.K.

Reinforced plastics

In the glass reinforced plastics field, while there are few advances in materials and techniques to report, there were a number of most interesting applications. Among materials the appearance of a fibrous-glass filled polystyrene injection molding material and several pre-mix polyester molding compounds should be noted. Polyurethane resin coated glass fabric and a polyurethane coated Terylene were both exhibited for their electrical use at elevated temperatures. Among the applications the most interesting was possibly the all-molded greenhouse which, in its smallest size, measures 9 ft. 1 in. by 6 ft. 6 in. by 7 ft. 6 in. high, and which can be extended by the addition of extra sections. This greenhouse, which was designed to take full advantage of light transmission properties of the material was exhibited as a design prototype, but is expected to be taken up for commercial production. On the present design it can be erected single-handed in a day from the component parts.

New machinery

The plant and engineering section in the exhibition was most international in character and 29 manufacturers from the Continent participated alongside U.K. manufacturers in this section. A number of new machines were displayed and developments in practically all processing techniques were noted, even though some were confined to modifications of existing machines.

Among the new injection molding machines was a fast cycle machine designed for automatic molding to a capacity of 5 oz. (polystyrene), and incorporating a selective variable double pack arrangement which increases capacity to 7½ oz. (polystyrene). Dry cycling time is 400 shots per hr., and plasticizing capacity 50 to 60 lbs. per hour.

Two models from another manufacturer of 30 to 40 and 50 to 60 oz. capacity were fitted with an "in line" pre-plasticator. This company incorporates a high capacity heating chamber on smaller machines which allows a very high plasticizing rate.

German machines included a 2-gram and a 40-gram high speed machine, the latter being demonstrated producing thin-wall polystyrene containers.

An interesting development is the low-pressure injection machine and a new model of this type was shown for the first time in the U.K. This machine embodies an extruder type screw and, using the principle of adiabatic working, enables injection at pressures as low as 2000 p.s.i.

Several types of extruders were

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shown for the first time. They included two new single-screw machines (3½- and 4½-in.), both of which have a 20:1 length/dia. ratio and a number of features including hydraulic variable drive with controlled torque, induction heating on the barrel, and independent zone cooling. They also embody a one-piece barrel. The 3½-in. machine was shown as part of a plant for the continuous production of polystyrene sheet which produces two sizes up to 30-in. wide and from 36 to 60-in. wide. The takeoff unit is adjustable for different widths and the guillotine unit incorporates photo-electric control of sheet length. Other new extruders included a 225-mm. vented machine,/and newly designed 1½-to 2-in., and 3½-in. single screw machines in which the barrel length can be varied to give a 10:1, 15:1, or 20:1 length/dia. ratio.

An interesting compression machine was an automatic quadruple cap molding press for thermosetting materials. This machine operates on a fixed cycle which can be adjusted for different components by varying cure time and temperature. Also in this section was a 25-ton high-speed alkyd molding press which was also used during the period of the show to carry out tests with a new 5 kw. pre-heater. The tests convincingly demonstrated the improvement in cycle time.

Among miscellaneous equipment was a standard model of a linear accelerator which is supplied to firms for irradiating plastics materials.

The only noteworthy development in glass reinforced plastics equipment was a new machine for spraying simultaneously a mixture of chopped glass reinforcement and the appropriate quantities of resin. The multiple spray nozzle supplies controlled quantities of air, fibrous glass, and mixtures of resin with catalyst and resin with accelerators.

A new coating machine for use with papers, textiles, and other webs employs a melt coat principle based on hot rollers on a calendering technique, rather than the more conventional extruder feed. The cold granules are fed into the first nip and finishes obtained are said to include both matt and high gloss. Coats can be clear, opaque, or colored.

A continuous measuring device for use in the production of thin film was demonstrated. This apparatus is based on an air jet system and the results are indicated by the behavior of manometer tubes corresponding to selected measuring stations or by pen recorders. It is said to be accurate to within ±0.00002 in. in a film range of 0.001 to 0.01 in. thick.

Readers interested in direct contact with any of the companies involved in the activities reported above can obtain specific names and addresses from the Editor, MODERN PLASTICS. A program of papers presented at the Convention was published on p. 194 of the June 1957 issue of MODERN PLASTICS. A full report of these papers will be presented by *British Plastics*, Iliffe & Sons Ltd., Dorset House, Stamford St., London, S. E. 7, England.—END

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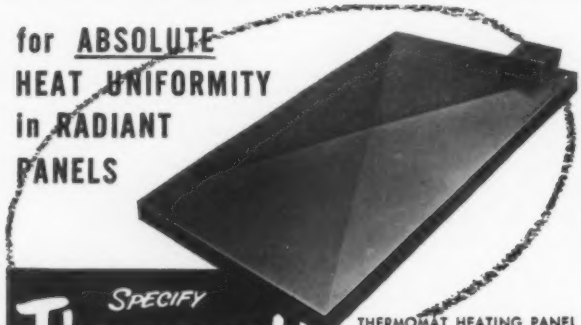

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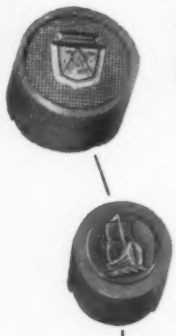

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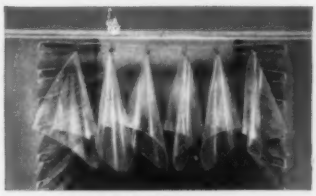

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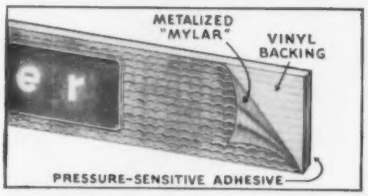

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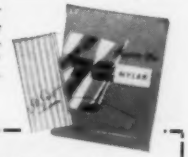

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New approaches

(*From pp.* 114-119)

about 1 million units a year; remodeling of old homes is a multi-million dollar business and rapidly growing . . . and plastics drawers can contribute importantly in both areas. Yet this potential has thus far hardly been tapped.

Probably the greatest stymie is the lack of well developed distribution channels. The experience of Reiss Mfg. Co. in this respect is noteworthy. For use with its styrene drawers, the company has developed a metal frame that makes installation of storage walls a simple task. Built 30⅛ in. wide to fit the standard 16-in.-center stud spacing (with one stud removed) and available in two- to six-drawer units, the frame can be put in place by simply screwing it to the studs. There is no problem of assembling and fitting. There also is no problem of assembling and fitting the drawers into the frame, since this fit is assured by the original design. Such a drawer-and-frame combination should be a fast selling item in today's housing market, despite its above-average price. The chances are that many a builder and remodeling homeowner have been wishing for just such a product. Yet the unit has been moving rather slowly, with distribution concentrated only in the New York-New Jersey metropolitan area. Reiss feels that its difficulties are due to the fact that the public has not been made aware of either the existence or the advantages of its product and is now hard at work to remedy the situation.

Cognizant of the problem, other molders have gone to great pains to assure proper distribution. When and if Panelyte decides to market a proprietary-type drawer to this field, for example, it seems likely that it would do so via its nationwide set-up of decorative laminate distributors. Prolon has assured its distribution throughout New England by getting its line into the hands of two major wholesale building supplies distributors. Knoll-Drake reports satisfactory nation-wide distribution.

The over-all problem

With the ten advantages listed earlier, plastics furniture drawers should have an assured future. In all three materials used—phenolic, styrene alloy, and reinforced plastics—production methods are well settled. Right now, the main problem—in addition to that of distribution—is one of selling: selling furniture designers and manufacturers on their superiority and selling the building contractor and the do-it-yourself public on their versatility and convenience.

Acknowledgements

The cooperation of the following companies, who supply phenolic and styrene alloy material to the plastics drawer industry, in the preparation of this article is gratefully acknowledged: Bakelite Co., a Div. of Union Carbide Corp.; The Dow Chemical Co.; and Monsanto Chemical Co., Plastics Div.

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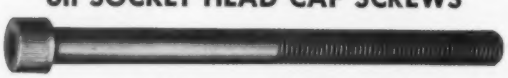

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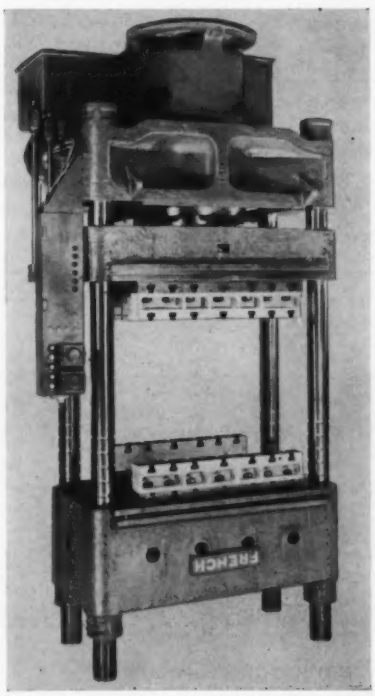

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Automatic molding

(*From pp.* 120-123)

into position and drop their charges into the cavities. Positive push-outs insure complete transfer of material into the mold. At the same time, a metal canopy shaped like a gabled roof moves beneath the raised half of the mold. As the molded parts are automatically ejected from the cores, two of them drop onto each side of the sloping canopy and are deflected to delivery chutes flanking each side of the mold. The canopy and power-loading device then contact a limit switch at the front of the press and withdraw from between the platens. The press closes automatically and the curing cycle begins.

The phenolic water-pump impellers, measuring 4¾ in. in diameter and weighing approximately 4½ oz., are produced in 12-cavity molds. A phenolic formulation having very low water absorption is employed.

As in the case of the 100-ton automatics, the 450-ton presses are operated in conjunction with high-frequency preheating ovens and circulating-oil type mold heating equipment. Provision is also made for feeding the molding material into a hopper directly from the Sealdbins in which it is delivered. Ford Motor Co. is using this automatic four-press installation for all its water-pump impeller production for the new Fords and Mercurys, as well as for replacement parts. Automatic molding of this part has enabled Ford to change from cast iron to phenolic as well as to cut cost, weight, and production time.

In molding the water-pump impellers, the production sequence begins with hand dropping of a sintered iron water-pump shaft insert onto pins in the lower half of each mold. The loading cup carrier then moves in, drops preheated powder in the cavities, and retracts. Next, the press closes, opens momentarily for breathing, and re-closes for the required cure time. At the end of the cycle, the press opens and the bottom ejection mechanism functions, holding the parts up on ejector pins. Finally, the ejector moves in, picks up the parts, and moves out of the press, dropping the finished parts.

These two phases of Ford's modern installation at Ypsilanti highlight the rapid progress being made in automated molding of high-volume parts. Under the impetus of sharpened competition and steadily rising labor costs, custom molders as well as captive molding plants cannot afford to overlook the possibilities of savings inherent in closely integrated installations of this type.

Credits: Presses, Baker Bros., Inc., Toledo, Ohio. Preheating ovens, W. T. La Rose & Associates, Inc., Troy, N.Y. Mold temperature control equipment, Industrial Control Div., Sterling, Inc., Milwaukee, Wis. Phenolic for distributor caps, Durez Plastics Div., Hooker Electrochemical Co., N. Tonawanda, N.Y., and Chemical Materials Dept., General Electric Co., Pittsfield, Mass. Phenolic for water-pump impellers, Durez. Sealdbins, U. S. Rubber Co., New York, N.Y.

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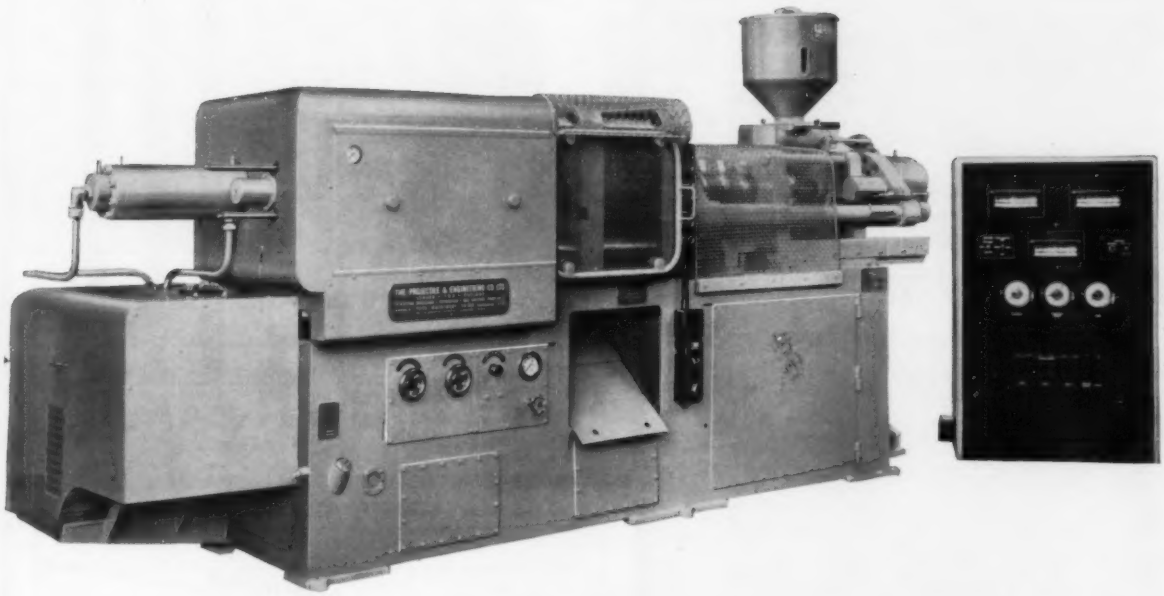

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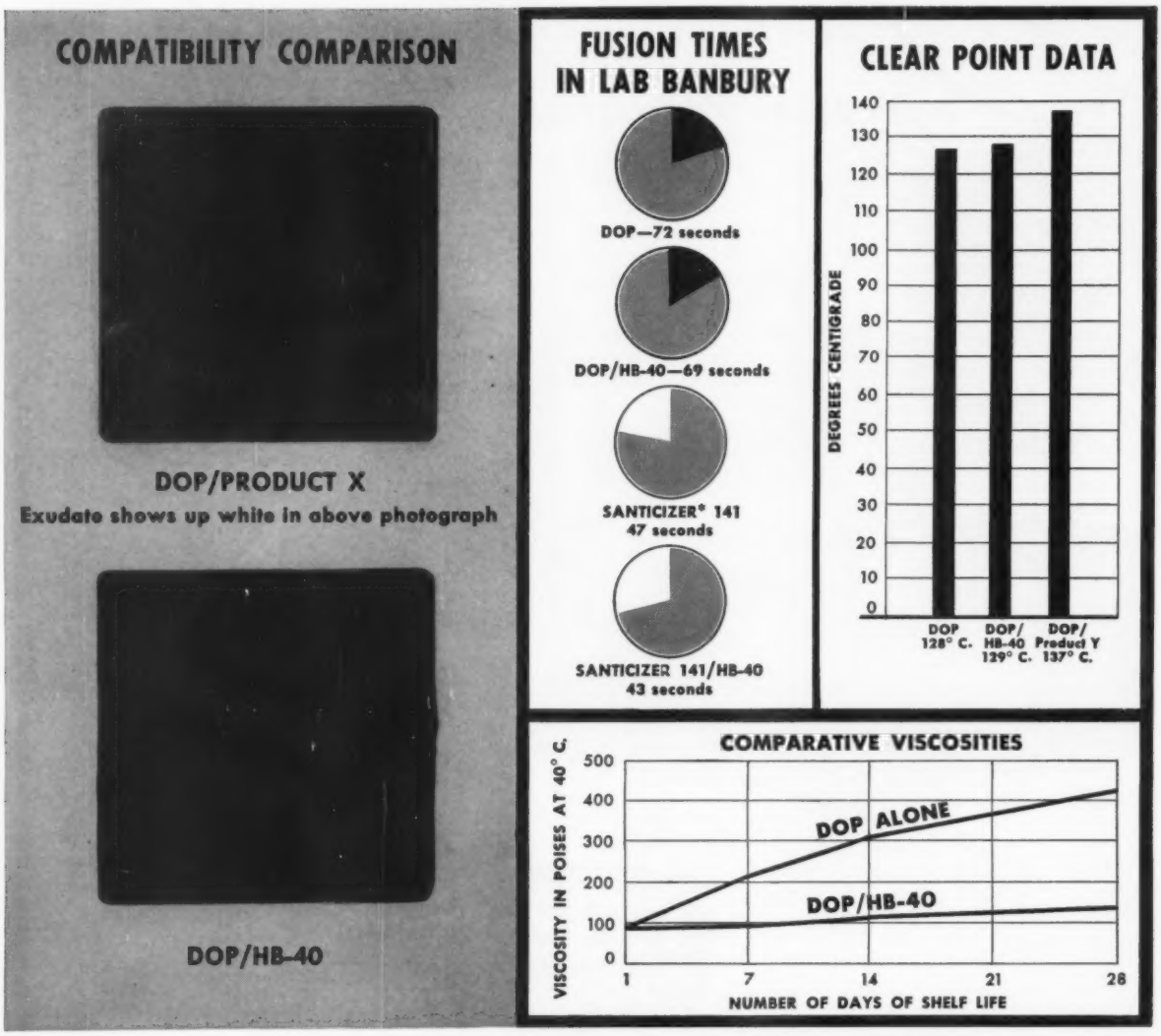

1. Better compatibility, viscosity stability, processibility

As the photos show above, HB-40* exhibits superior compatibility. Miscible with almost all PVC plasticizers, HB-40 is useful with many other resins. As a low-cost secondary, HB-40 extends your dollars' worth by extending high-cost primary plasticizers. Versatile HB-40 doubles as a viscosity control agent in DOP/PVC plastisols. Extended shelf life means fewer gelled batches, builds your reputation as a desirable supplier. Fast fusion rates and low clear points establish the high processibility of HB-40. Companies who Banbury, dry blend, roll mix, calender or extrude gain production rate increases and improved product quality through more complete solvation by including HB-40. Molders and casters achieve shorter fusion cycles, more parts per hour.

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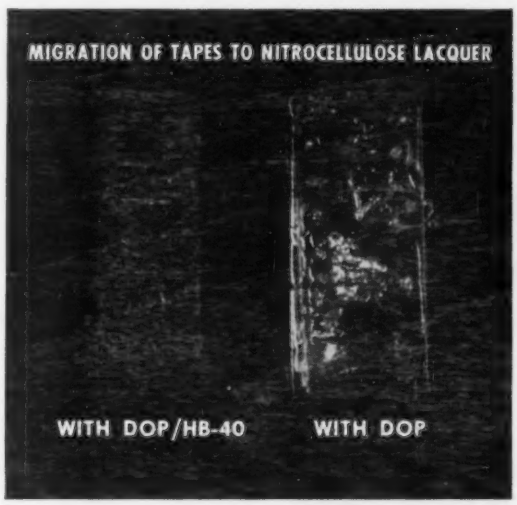

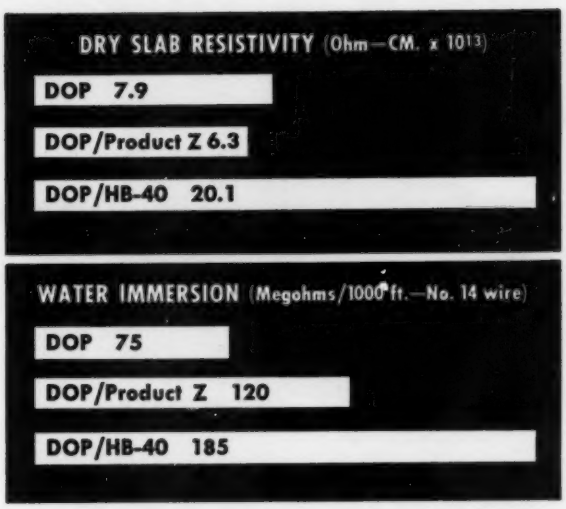

2. High migration resistance to nitrocellulose

In polyvinyl chloride formulations, HB-40 shows excellent migration resistance to nitrocellulose lacquers. This means no marring, softening or lifting of nitrocellulose lacquered finishes on furniture, appliances, automobiles. Any vinyl-coated product can remain on table tops, cabinets, dashboards for reasonable lengths of time with no resultant damage IF the vinyl product has been made from a formulation adequately fortified with HB-40. A unique advantage!

3. Excellent electrical properties

Note the outstandingly superior performance of DOP/HB-40 formulations over straight DOP and DOP plus another secondary plasticizer in the Dry Slab Resistance and Water Immersion tests. Improved electrical properties and reduced compound costs result when HB-40 is substituted for part of the primary plasticizer in polyvinyl chloride electrical formulations. Cost reduction teamed with product improvement is a hard-to-beat combination in the electrical insulation industry.

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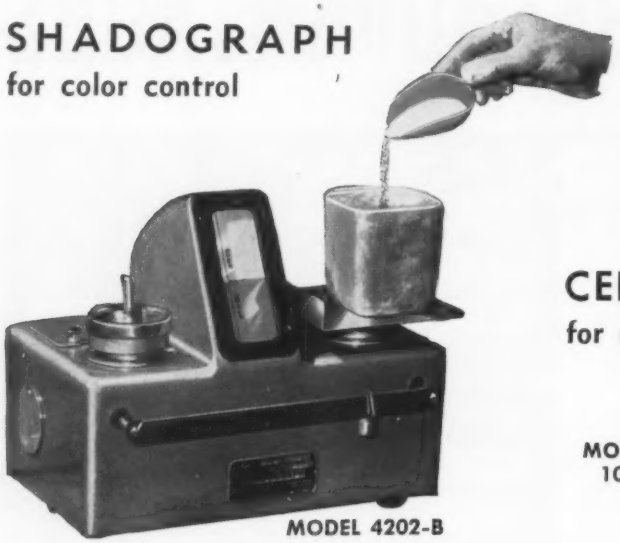

MODEL 4202-B

The Shadograph is engineered on a design principle utilizing a projected beam of light. The result is fast, ultra-visible weight indication without parallax readings. Weighs accurately in out-of-level positions. Capacities from one gram to 100 lbs. Write for Bulletin 3333.

Shown on this page are only a few models from the broad line of Exact Weight Scales made specifically for the plastics industry. They include specialized models for pre-weighing plastic materials, for pre-form production, check weighing pre-forms, counting parts by weight, bagging and drum filling, color blending, weigh feeding.

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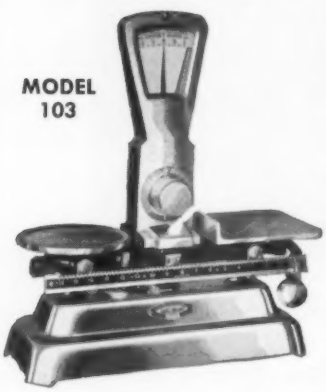
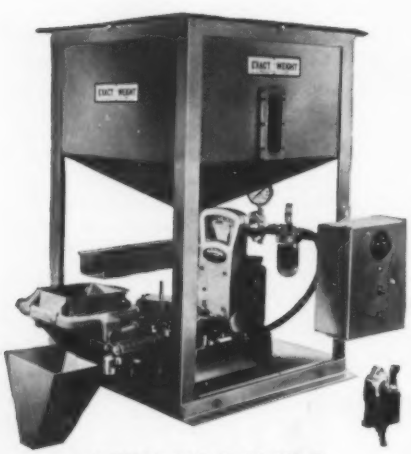
MODEL 103



This scale provides accuracy with speed in all checkweighing operations. Indicator travel of 1 inch equals 1 ounce. Graduations down to 1/16 ounce. Capacity 3 pounds. Unaffected by machinery vibration and weighs accurately in out-of-level positions. End tower models also available.



MODEL 610·F·00·IM·2

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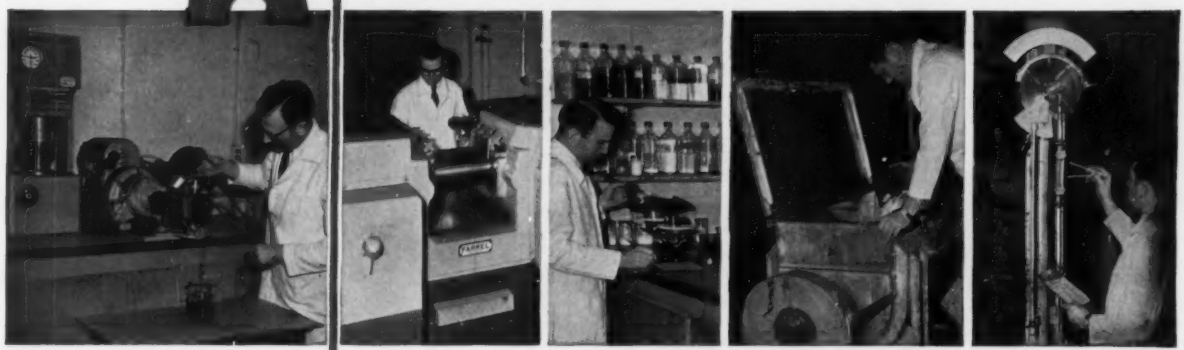

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PLASTICS EQUIPMENT. Illustrated catalog sheet describes injection and compression presses, extruders, mixers, ovens, embossing and laminating machines, and Banbury mixer offered by New Jersey distributor. Prices included. Johnson Machinery Co. (J-701)

ADHESIVES FOR PLASTICS. Chart provides information on properties of 30 typical adhesive formulations taken from a series of adhesives offered by this company for bonding plastics and metals. Rubber & Asbestos Corp. (J-702)

EXTRUDERS. Illustrated catalog describes line of extruders with diameters from 1¼ in. through 12 in. Also covers auxiliary equipment including film dies, take-up unit, pelletizers, cooling and polishing roll assemblies. Specifications included. Hartig Engine & Machine Co. (J-703)

HEAT SEALING EQUIPMENT. File folder contains catalog sheets describing a line of electronic heat sealers, preheaters, generators, and other heat sealing equipment. Radio Receptor Co., Inc. (J-704)

SPRAY MASKS. 20-page brochure illustrates and describes wide range of spray masking devices and decorative effects that can be achieved with these masks. Also discusses mask jigs and fixtures. William M. Fiore, Inc. (J-705)

ELECTRONIC CONTROL SYSTEMS. Folder describes company's facilities for the production of custom electronic control systems, including a system for measuring weights or thickness of sheet material. Curtiss-Wright Corp. (J-706)

SHEETS, RODS, TUBES. Properties chart lists electrical, mechanical, thermal, chemical and physical properties of commonly used plastics fabricating materials, including nylon, acrylic and acetate. Commercial Plastics & Supply Corp. (J-707)

HIGH SPEED PRESSES. Folder illustrates hydraulic presses designed for operations where high closing speed and a comparatively short pressure stroke is desirable. Includes cross-section diagram and specifications chart. Davidson-Kennedy Co. (J-708)

RODS AND TUBES. Folder provides technical data, properties of laminated thermoset tubes and rods available from this company. Spaulding Fibre Company, Inc. (J-709)

FILM FOR SILK SCREENING. Illustrated folder describes a solvent adhering film for silk screen process printing. Ulano Products Company. (J-710)

PLASTICIZERS FOR VINYLS. 20-page brochure provides data on applications, properties, characteristics of company's line of plasticizers for vinyls. Harchem Div., Wallace & Tiernan. (J-711)

ELECTRIC RADIANT HEATERS. Folder describes fused quartz electric radiant heaters available in single or multiple units, panels, or complete oven assemblies. Specifications included. Cleveland Process Co. (J-712)

EDGER AND TRIMMER FOR LAMINATED SHEET. Illustrated folder describes edger and trimmer combination for laminated plastic sheet that sizes 1,500 to 2,000 sheets per hour. Discusses principal features. Kalheim Machinery Co. (J-713)

TACHOMETER CATALOG. 12-page catalog contains illustrations and specifications for line of tachometers for indicating changes in speed of equipment. Includes portable models. Jones Motrola Corp. (J-714)

NYLON MANUAL. 16-page illustrated booklet describes applications and properties for line of nylon rods, sheets and tubing. Discusses fabricating technique and special considerations for designing nylon parts. The Polymer Corporation of Pennsylvania. (J-715)

SYNTHETIC WAXES. 16-page booklet describes line of synthetic waxes used with plastics as an anti-static and anti-tack agent, as a polish and as a mold release. Lists properties. Glyco Products. (J-716)

INDUSTRIAL SCALES CATALOG. Illustrated folder describes and lists capacities of extensive line of industrial scales, including floor, overhead track, hopper, bench and portable types. Toledo Scale Co. (J-717)

ROTARY GRANULATORS. Illustrated folder describes two rotary granulators for plastics materials. Also describes granulator equipped with cooling fan for working heat-sensitive or warm plastics. Includes specifications. Lukens Laboratories. (J-718)

FIBROUS GLASS REINFORCEMENT SAMPLE. Folder describing "Fabmat," company's reinforcing mat contains sample section of mat. Price list included. Fiber Glass Industries, Inc. (J-719)

COLOR CONCENTRATES FOR EPOXY RESINS. Folder discusses use of company's liquid epoxy paste color concentrates used as a colorant for epoxy resins in casting and laminating applications. List of resin suppliers, prices included. Ferro Corp. (J-720)

VIEWING COLOR UNDER LIGHT. Illustrated folder discusses use of fluorescent lighting fixture for use in color matching of pigments, dyes or colorants. Macbeth Daylighting Corp. (J-721)

POLYESTER PRE-IMPREGNATED GLASS CLOTH. File folder contains sample, technical data on flame-resistant polyester resin pre-impregnated glass cloth for use in laminates for electrical and electronic applications. Standard Insulation Co. (J-722)

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PLASTICIZERS. Booklet provides descriptions, properties, prices for plasticizers in company's extensive line. Thompson Chemical Co. (J-723)

INJECTION PRESSES. Folder provides illustrations and specifications for company's 2, 4 oz. injection presses, and points out design features. Moslo Machinery Co. (J-724)

REINFORCING MATERIAL. Booklet describes "Troytuf" polyester fiber and acrylic fibre reinforcements, recommended for use in laminates to be painted, or exposed to extreme weather conditions. Includes graphs and charts of properties. Troy Blanket Mills. (J-725)

MOLDED PLASTICS MANUAL. 8-page booklet contains case histories of molded plastics applications developed by Illinois custom molding service, that includes design, mold making, compression, transfer, injection molding. Also discusses "Insurok" laminated plastics. The Richardson Co. (J-726)

INJECTION HEATING CYLINDER ACCESSORIES. Illustrated literature describes line of heaters, thermocouples, and controllers for injection presses. Prices included. Injection Molders Supply Co. (J-727)

INFRARED DRYING FOR LAMINATING. Illustrated report describes use of infrared oven for drying and curing resin-impregnated cloth or paper prior to laminating. Edwin L. Wiegand Co. (J-728)

MELTING EQUIPMENT. 8-page booklet contains illustrations and descriptions of melting equipment for resins, waxes, adhesives, and similar materials, including rectangular tanks, agitators, heaters, and low pressure tanks. Sta-Warm Electric Co. (J-729)

POLYESTER RESINS. Handbook describes characteristics of "Glidpol" line of polyester resins. Applications described include laminating, casting, impregnating, and surface coating. The Glidden Co. (J-730)

INJECTION PRESSES. Illustrated brochure gives features and specifications of line of 4, 8, 12, 20, 60 oz. injection molding presses. Specifications chart included. The Lester Engineering Co. (J-731)

MACHINE MOUNT. Illustrated 12-page brochure describes a vinyl-sisal-cork "Air-Loc" pad upon which machines are mounted to absorb vibrations and shock loads. Includes illustrations and applications. Clark-Cutler-McDermott Co. (J-732)

PLASTICIZER FOR VINYL RESINS. 12-page technical bulletin gives physical properties, data on line of plasticizer and plastisol extrusion applications. Continental Oil Co. (J-733)

ASBESTOS FIBRES FOR REINFORCED MOLDING COMPOUNDS. Technical bulletin describes characteristics of company's asbestos fibres for use in reinforcing polyester molding compounds. Asbestos Division, World Commerce Corp. (J-734)

THERMOPLASTIC RESIN. Folder illustrates applications and discusses properties for company's "Cycolac," a high-impact polystyrene copolymer. Marbon Chemical Division, Borg-Warner. (J-735)

SHEET, ROD, TUBING. Folder provides properties for polyethylene and polystyrene sheet, rod, tubing, methacrylate rod and tubing, and "Styrofoam" board, log, plank stock. Discusses applications. Price lists included. Crystal-X Corp. (J-736)

MEASURING VISCOSITY. Illustrated folder describes operation, design features of company's "Viscometran," a unit that continuously measures viscosity in processing operations. Brookfield Engineering Laboratories, Inc. (J-737)

SITE FOR MANUFACTURING PLANT. Illustrated literature discusses Gardner, Mass. as site for locating manufacturing plant. Includes data on labor supply, and power facilities. Gardner Industrial Foundation. (J-738)

CUSTOM NYLON MOLDING. Folder describes Ohio company's facilities for short-run custom molding small-size nylon parts. Nylon Molded Products Corp. (J-739)

PROCESSING EQUIPMENT. Literature describes line of injection presses with 1, 2, 2½ oz. capacities. Also describes company's base assemblies and a scrap granulator. The Van Dorn Iron Works Co. (J-740)

TEMPERATURE CONTROLLERS. Illustrated catalog describes line of temperature controllers, control systems, and thermocouples for use in plastics processing. West Instrument Corp. (J-741)

42-TON HYDRAULIC PRESS. Illustrated folder describes 42-ton hydraulic press with 12 x 12 in. platens, recommended for laboratory use. Includes diagram of press with specifications. Erie Engine & Manufacturing Co. (J-742)

GLASS-REINFORCED MOLDING COMPOUNDS. Folder lists typical applications for company's glass-reinforced nylon and polystyrene molding compounds. Includes full-page properties chart. Fiberfil, Inc. (J-743)

INJECTION PRESS CATALOG. Illustrated catalog contains comprehensive description of company's line of 14 to 60 oz. capacity injection presses. Provides detailed discussion of features. National Automatic Tool Co., Inc. (J-744)

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New markets

(*From pp.* 124-128)

eventually make important contributions to rigid urethane foam.

An interesting possibility for urethane is underscored by a recent move by American Latex Products Corp., foam manufacturer of Hawthorne, Calif. The company has introduced a series of special urethane formulations for spray-gun coating of flat or contoured surfaces. The foam, applied with DeVilbiss catalyst spray equipment, will expand in place to any desired thickness between ⅛ and 2 in., to form a bond stronger than the material itself. Densities between 2 and 20 lb./cu. ft. can be obtained, and applications include thermal, sound, and electrical insulation, vibration dampening, and various uses as a void filler.

A new type of rigid foam, based on unsaturated polyesters and foamed by mechanical means, is now in the development stage. The foam is related to urethane, but uses no isocyanate—and therein lies its chief advantage, since it replaces the most expensive ingredient in urethane foam, which makes up about 30% by volume of the material. Vanguard Products, Newark, N.J., is doing the work on "Estafoam," which should sell for about 25% less than current prices for rigid urethane, according to a Vanguard spokesman. As a true thermoset material, polyester foam would have a somewhat higher temperature resistance than urethane, and would, of course, bond without adhesive to a polyester-glass building panel skin.

Vinyl

The third most important member of the rigid foam family is probably vinyl, that masterpiece of versatility. Several companies are now in production of rigid vinyl foam, for one application that overshadows any others: flotation equipment. In this market, vinyl has two properties to sell against the strong competition of foamed styrene—a self-extinguishing characteristic and greater physical strength. Among the firms producing vinyl foam for

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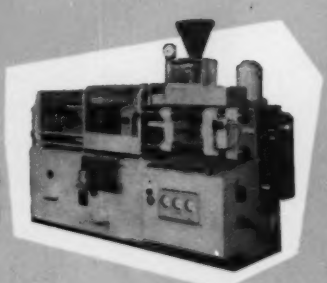

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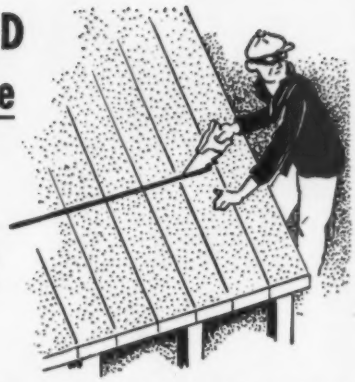

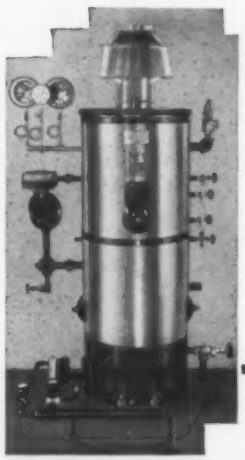

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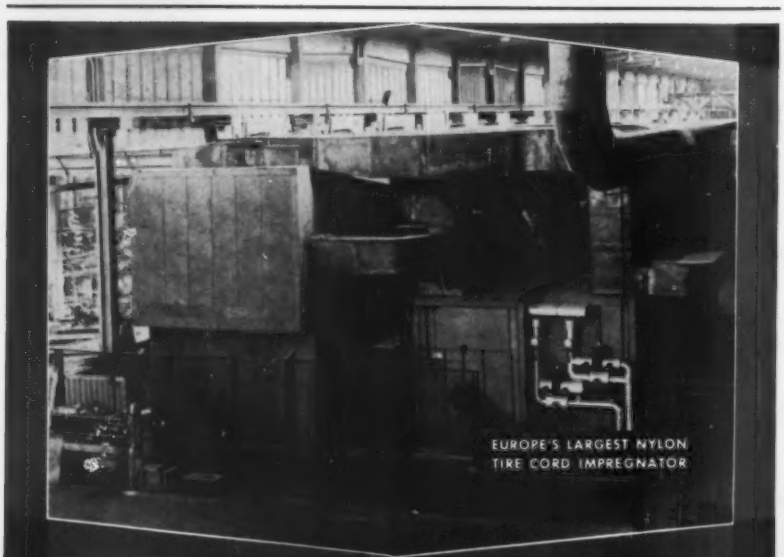

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marine use are Sponge Products Div. of B. F. Goodrich, Shelton, Conn.; Floatex, Inc., Sterling, Conn.; and Linen Thread Co., Paterson, N.J. The latter firm uses rigid vinyl foam in fish net floats, an application which one observer described as moving so fast it may conceivably push cork right out of the picture in the immediate future.

Phenolic

Phenolic foam is perhaps the oldest of all the plastics foams, and its combination of low cost, extreme light weight (as low as 0.3 lb./cu. ft.), high heat resistance (300° F.) self-extinguishing characteristics, and excellent acoustical properties have fascinated engineers for a long time. Nevertheless, phenolic foam has never gotten off the ground commerically, though it has found some use in specialty packaging and sandwich building panel construction. In all applications, however, phenolic foam has been more experimental than commercial.

The problems with the material are extreme friability (a brick of the foam can be crumbled in the hand) and a reaction that is difficult to control with the necessary exactness. Phenolic can be foamed in place, but the process involves handling of acids and noxious fumes. As a pre-foamed material, phenolic would have to compete price-wise with Styrofoam. This is something of a possibility, if and when Bakelite, the main producer of this material, manages to bring raw material costs down about a third.

Syntactic

A related material, syntactic foam, is much younger but in about the same dormant commercial state as phenolic foam. Syntactic foam is made up of microscopic nitrogen-filled phenolic spheres, bonded together with either phenolic, epoxy, or polyester resins. The material, also a Bakelite brain-child, is a rather unique concept in foamed plastics. The spherical shape of the particles contributes greatly to its physical strength properties; and the material is said to have the best strength-to-weight ratios of any

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The following three materials are vinyl chloride — vinyl acetate suspension copolymers.

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SOLVIC 535 E — Vinyl acetate content: 5%. USES — General purpose copolymer.

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SOLVIC 100 series (122, 124, 136)
General- and special-purpose PVC resins, manufactured by the emulsion process; suitable for unplasticized extrusion and calendering, for blow-extrusion of unplasticized films, for injection moulding of unplasticized articles; Solvic 122 is prestabilized with non toxic products.

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This Fact Book by MOCO engineers on the basic operating principles of heat processing ovens should prove interesting. If you have specific questions, please write.

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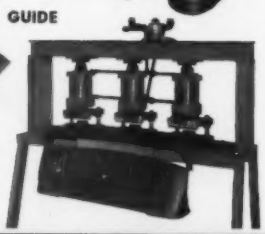

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expanded plastic. The best potential for syntactic foam is seen as a core material in sandwich panels.

Cellulose acetate

A long-established but not so well-known plastic foam, cellular cellulose acetate (CAA), has done much better commercially. CAA is notable for its thermal resistance (350° F. for extended periods); at the same time it has good tensile and sheer strength. CAA is produced by Strux Corp., Lindenhurst, N.Y., under a Du Pont license. It is manufactured by a continuous extrusion process wherein acetate flake is converted to a rigid foam by flash evaporation of a volatile solvent. The advantage of the extrusion process is that unlimited lengths may be fabricated. The cross-sectional area, of course, cannot be too large since it is limited by the size of the extruder.

In densities of 5 to 8 lb./cu. ft., CAA has been used in a number of interesting applications, such as gun plugs for jet fighters, and for various packaging purposes, but the biggest potential for the foamed acetate material is probably in the building field as a core material in sandwich panels and other areas.

Urea-formaldehyde

As a foamed material, urea-formaldehyde has two main virtues: low density and good sound absorption. Urea foam is offered commercially by Colton Chemical Co., Div. of Air Reduction Co., Cleveland, Ohio, in 0.8 lb./cu. ft. density. Two forms are available from the company: blocks and shredded insulation.

Thermal resistance of the foam is relatively low (120° F.), but it is not affected by prolonged exposure to extreme low temperatures.

Urea foam, at roughly the same price as foamed styrene, is competing for similar markets: low temperature insulation in household and commercial refrigeration units, and the display and novelty fields.

Rounding out the list of rigid plastic foams are three materials each of which has a single unique property which should virtually assure them a strong position in

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certain solid, if specialized markets—silicone, epoxy, and cellular polyethylene.

Silicone

Silicone foam has the highest heat resistance of any expanded plastic. Samples have been exposed to 700° F. for 72 hrs. with only slight dimensional change. The insulation value of silicone foam is so high that a 2-in. brick (and this makes an eye-popping demonstration) can be heated cherry red on one side while the other side remains cool to the touch. Supplied by Dow Corning Corp., Midland, Mich., silicone powders are foamed by the application of heat in a suitable mold. The company is now working on a three-component foaming system that can expand in place at room temperatures. Still in the development stage, it is available only in limited quantities. Though they have broad potential within the sphere of high-temperature insulation applications of silicone foams will probably be limited because of friability and high cost. Another disadvantage is the long post-cure which is required for maximum high-temperature performance.

Epoxy

Epoxy foam has also aroused considerable interest because of one application for which it is a natural: potting of electrical and electronic components, especially where weight saving is important. In general, epoxy foams are strong and have good heat resistance and adhesive qualities, as well as excellent chemical resistance and dielectric characteristics. But the high price of epoxy will probably prevent foam from achieving widespread use except when it will do jobs where nothing else will answer.

Among the sources of epoxy foam today are De Bell & Richardson, Inc., Hazardville, Conn., which offers pro-foamed blocks of 5 to 20 lb. density; Emerson and Cuming, Canton, Mass., which manufactures a sheet material; and Furane Plastics, Inc., Los Angeles, Calif., which offers a foamed-in-place system that can be used without the application of external heat.

De Bell & Richardson, through its affiliate, D & R Pilot Plants, Inc., has been selling its large blocks of epoxy foam (1 by 2 by 6 ft.) for the manufacture of checking fixtures for the aircraft industry. The foam cuts cleanly with wood-working tools and can be cemented with any thermoset adhesive. For a smooth surface, the foam is either wrapped in layers of epoxy-glass cloth or a skin of polyester. The advantage of using foam for checking fixtures instead of conventional epoxy resins is said to be ease of handling and a faster production rate.

Polyethylene

Cellular polyethylene does not resemble the other foams very much, since it is being expanded to only twice the volume of conventional polyethylene. Specific gravity is 0.47 compared to 0.92. For most purposes, it can be considered as simply a version of the big-volume plastic that is only half as heavy: that's its chief value.

As wire insulation, cellular polyethylene offers high dielectric properties with half the weight; it is especially useful for such applications as television lead-in wire, coaxial cable, and wherever there are weight and handling problems in finished wire construction.

Cellular polyethylene is produced with the aid of a blowing agent and an extruder. Besides wire insulation, it has been turned out in rods, shapes, and sheeting, for gasketing and closure lining applications.

The rigid plastics foams, as a whole, offer a large and infinitely varied "set" of new materials to industry. They constitute a family that cannot help reaching big volume. Twenty years ago foamed plastics were laboratory curiosities; today they are commercial products; ten years from now many of them will be in large-scale use. Foamed plastics permit new manufacturing techniques that are already simplifying operations, saving money, and making new products possible. And they promise to ultimately yield a great deal more of these advantages when they are better understood.—End

Hazen color test on 3 monomeric low-temperature plasticizers, made with 3 different dibasic acids esterified with the same alcohol, shows U.S.I. Isosebacic® acid results in lightest color product. It is a synthetic; whereas the other intermediates are derived from vegetable and animal oils.
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Isosebacic acid is a mixture of three C_{10} dibasic acids – 2-ethyl suberic acid, 2,5-diethyl adipic acid and sebacic acid.

PHYSICAL PROPERTIES

Molecular weight	202.24
Combining weight	101.12
Density (80°C)	1.025g/ml
	8.55#/gal
Melt viscosity (80°C)	78.5 centipoises
Specific heat of vapor (226°C)	0.34 cal/g (est.)
Heat of vaporization (226°C)	107 cal/g
Specific heat of solid (24°C)	0.33 cal/g
Heat of combustion	1296 K cal/mole
Flash point (closed cup)	430°F
Ionization constant at 25°C	$K_1 = 3.5 \times 10^{-5}$
	$K_2 = 5.1 \times 10^{-6}$

CHEMICAL PROPERTIES

1. Undergoes typical reactions of the dibasic acids.
2. Reacts with alcohols to yield both acid and neutral esters.
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4. Relatively stable material, not oxidized by air at ordinary temperatures.

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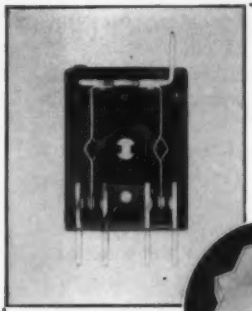

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International plastics

(*From p.* 129)

recommended practices for compression and injection molding of thermoplastic materials and compression molding of thermosetting materials, and standard atmospheres for conditioning and testing plastics.

Working Group No. 1 on Nomenclature and Definitions has completed the preparation of a list of 858 equivalent terms relating to plastics in six languages (English, French, Russian, German, Italian, and Spanish) and provisional definitions. The document has been transmitted to the ISO General Secretariat in Geneva for circulation to the 38 member countries as a Draft ISO Recommendation. The working group is now compiling nationally agreed definitions of terms for the purpose of arriving at internationally accepted definitions.

Working Group No. 2 on Mechanical Strength Properties has ISO documents relating to flexural, tensile, and impact properties in various stages of review by member countries. It is now engaged in the preparation of methods for the determination of compressive, shear, and creep properties, modulus of elasticity, and indentation hardness.

Working Group No. 3 on Standard Laboratory Atmosphere and Conditioning Procedures reviewed a report by A. C. Webber on agreements reached by ISO/ATCO at a meeting in Paris on May 6-7, 1957. The ATCO committee was organized to coordinate decisions of individual ISO and IEC Technical Committees in regard to atmospheres adopted for conditioning and/or testing of specimens under approximately ambient conditions. The Paris meeting was attended by representatives of 19 committees of ISO and IEC. It proposed that selection of standard atmospheres for conditioning and testing be limited to the following:

20° C. and 65% relative humidity
23° C. and 50% " "
27° C. and 65% " "

These conditions were incorporated by Working Group No. 3 in a Draft ISO Proposal approved for circulation to ISO/TC 61 member bodies. The working group is studying conditioning procedures for polyamides and methods of producing and measuring atmospheres of specified relative humidity.

Working Group No. 4 on Thermal Properties has drafted methods for determining heat distortion temperature, incandescence resistance, and melt flow index. It is presently engaged in the preparation of proposals for measuring flammability, flow properties, softening point, hot-needle penetration of thermosetting materials, and stiffness properties of plastics as a function of temperature.

Working Group No. 5 on Physical Chemical Properties has prepared 12 Draft ISO Recommendations pertaining to analysis of phenolic and polystyrene molding compounds, apparent densities and bulk factor of molding powders, water absorption, and viscosity of polyvinyl chloride. Additional methods under study by

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TENSILE STRENGTH (psi)	5,800
FLEXURAL STRENGTH (psi)	11,900
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@ 72°F	15 Minimum—19 Maximum
@ 32°F	3 Minimum
@ –16°F	1.7 Minimum
After 150 hrs. under General Electric S-1 Bulb . . . Ambient Temperature, 150°F	10 Minimum
HEAT DISTORTION TEMPERATURE (at 264 psi) (°F)	145.4
HEAT DISTORTION TEMPERATURE (at 66 psi) (°F)	154.4
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GRAVES TEAR (with Grain) (Lbs/inch. thickness)	630
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this group include resin content of phenolic molding materials; percentage of chlorine in polyvinyl chloride; degree of cure, gel time, and maximum temperature attained in the setting of polyesters; pH and electrical conductivity of water extracts of plastics; and viscosity of polyamides, cellulose acetate, and polystyrene.

Working Group No. 6 on Ageing, Chemical, and Environmental Resistance has drafted methods for studying the resistance of plastics to chemicals, loss and migration of plasticizers, thermal stability of polyvinyl chloride, and bleeding of colorants from plastics. It is studying the determination of resistance of plastics to light, moulds, and soils, and changes in mechanical properties after contact with chemicals.

Working Group No. 7 on Preparation of Test Specimens has prepared practices for molding test specimens of both thermoplastic and thermosetting materials. It is working on the standardization of dies for producing 10- by 4-mm. specimens for flexural strength and heat-distortion temperature tests, and a 50-mm. disk for water absorption, resistance to chemicals, and loss of plasticizer tests.

Working Group No. 8 on Electrical Properties was organized to review methods prepared by Technical Committee 15 on Electrical Insulating Materials of the International Electrotechnical Commission to determine their suitability for testing plastics. IEC/TC 15 has drafted methods for measuring volume and surface resistivity, insulation resistance, and tracking. Working Group No. 8 is also investigating the use of volume resistivity for assessing the degree of homogeneity of solid insulating materials, electrodes for measuring volume and surface resistivities of plastics, conditioning of test specimens before and during electrical tests, and corrosion of metals in contact with plastics. The standardization of thickness tolerances for paper- and fabric-base phenolic laminates is also being considered.

The next meeting of ISO/TC 61 will be held in Washington, D. C., on November 3-8, 1958. Tentatively, approximately 45 delegates from abroad are plan-

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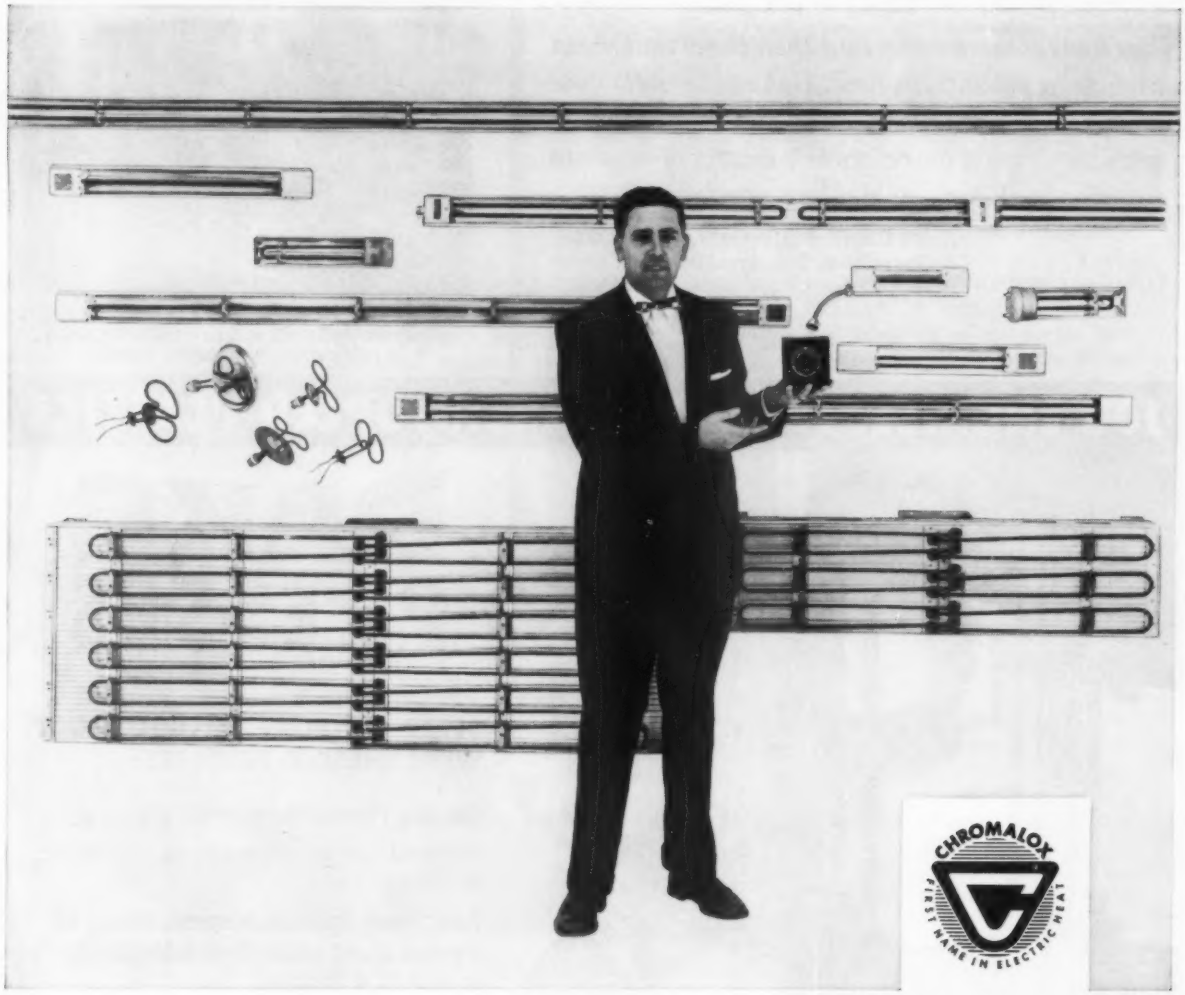

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ning to attend. The meeting will be preceded by a two-day symposium in Philadelphia on October 30-31 under the sponsorship of A.S.T.M. Committee D-20 on Plastics. An invitation was received from the German delegation to hold the 1959 meeting of ISO/TC 61 in Munich, Germany.

IUPAC Plastics and High Polymers Div.

A symposium on scientific principles relating to testing of elastomers, fibers, and plastics was held in Paris on July 25-26 under the sponsorship of the Plastics and High Polymers Div. of the Applied Chemistry Section, International Union of Pure and Applied Chemistry, with approximately 250 in attendance. The program, organized by Prof. P. Dubois, who holds the Chair of Plastics at the Conservatoire National des Arts et Metiers, consisted of three plenary lectures and 31 papers (seven from the United States). The plenary lecturers and their subjects were:

1) Prof. H. Mark (U.S.): "Principles of ductile and brittle fracture."

2) Prof. P. Piganiol (France): "Composition, structure, and electrical properties of high polymers."

3) Dr. K. Wolf (Germany): "Relationships between structure of high polymers and their behavior in alternating fields."

This symposium was part of the 16th IUPAC Congress held in Paris July 18-26. The Congress was attended by over 3000 chemists from 48 countries. Seventeen plenary lectures and approximately 900 papers were presented. The opening session was highlighted by a lecture by Prof. G. Natta on "Stereospecific catalysis and stereoisomeric polymers. Preparation of new fibers, plastics, and elastomers."

The next biennial IUPAC Conference will be held in Munich, Germany, in Sept. 1959. The Congress will include a Section on Applied Chemistry.

IUPAC Macromolecular Commission

New officers for the period 1957-1961 were named at the meeting of the Macromolecular

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Commission of the IUPAC Div. of Physical Chemistry in Paris on July 18-20. Dr. H. W. Melville (Great Britain) is the new president succeeding Dr. H. Mark, and Dr. P. C. Doty (United States) is the new secretary. The national representatives from the United States are Paul Flory, Herman Mark, and Emil Ott. Discussions were held on nomenclature and fractionation of high polymers.

It was announced that there would be 20 plenary lecturers and 170 papers at the symposium to be held in Prague, Czechoslovakia, on Sept. 9-15, 1957. Fourteen papers and 20 participants are expected from the United States.

The Macromolecular Commission will sponsor an international conference on high polymers at the University of Nottingham, England, July 21-24, 1958. It is being organized under the chairmanship of Dr. H. W. Melville, Dept. of Scientific and Industrial Research, Charles House, 5/11 Regent St., London, S. W. I. Proceedings will be divided between the two following sections:

Section A. Reaction mechanisms and kinetics.

1) Heterogeneous polymerization (including trapped or inactive radicals).

2) Production of graft and block copolymers.

Section B. Physical, thermodynamic, and mechanical properties.

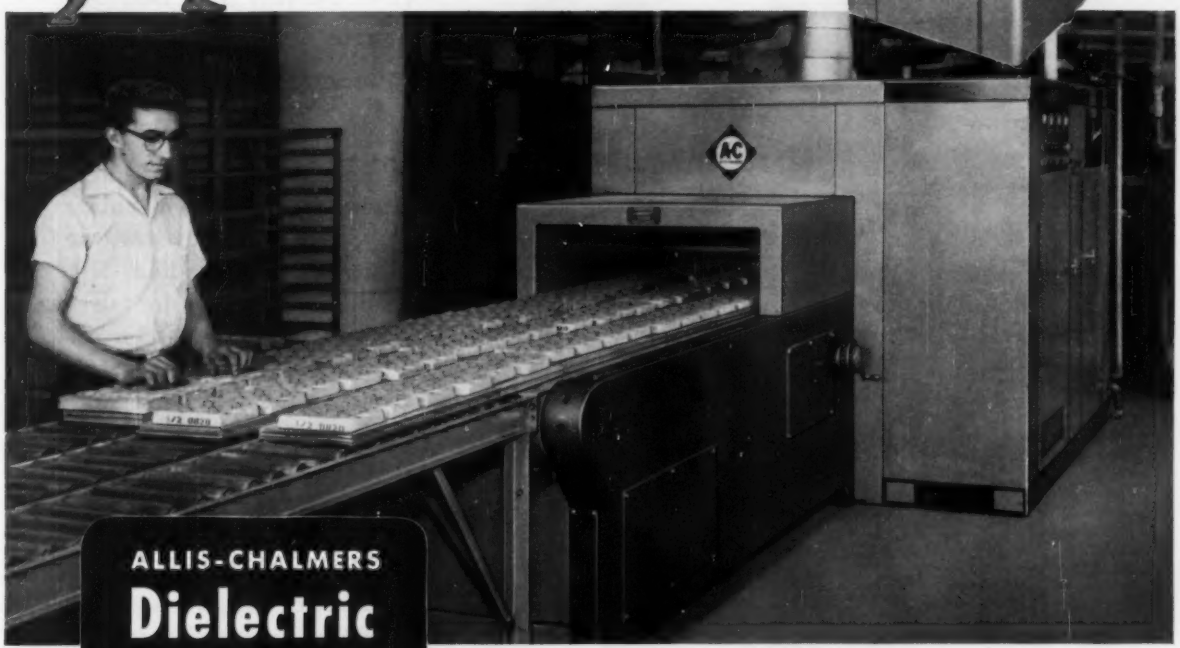
1) Stereospecific polymers.

2) Graft and block copolymers.

3) Other materials.

It is proposed to limit papers to approximately 20 in each section and to circulate preprints before the meeting, so as to allow ample time for discussion. Anyone wishing to present a paper is invited to submit an abstract of 200 to 300 words in English, French, or German, not later than Dec. 15, 1957. The organizing committee will make up its program by selection from these abstracts, and will invite the authors to prepare completed papers. These will be required not later than March 1, 1958. Papers not received in time for circulation in preprint form cannot be included in the conference. The full proceedings of the conference, will be published in a special number of the *Journal of Polymer Science*.—END

in the laboratory...
on the production line...



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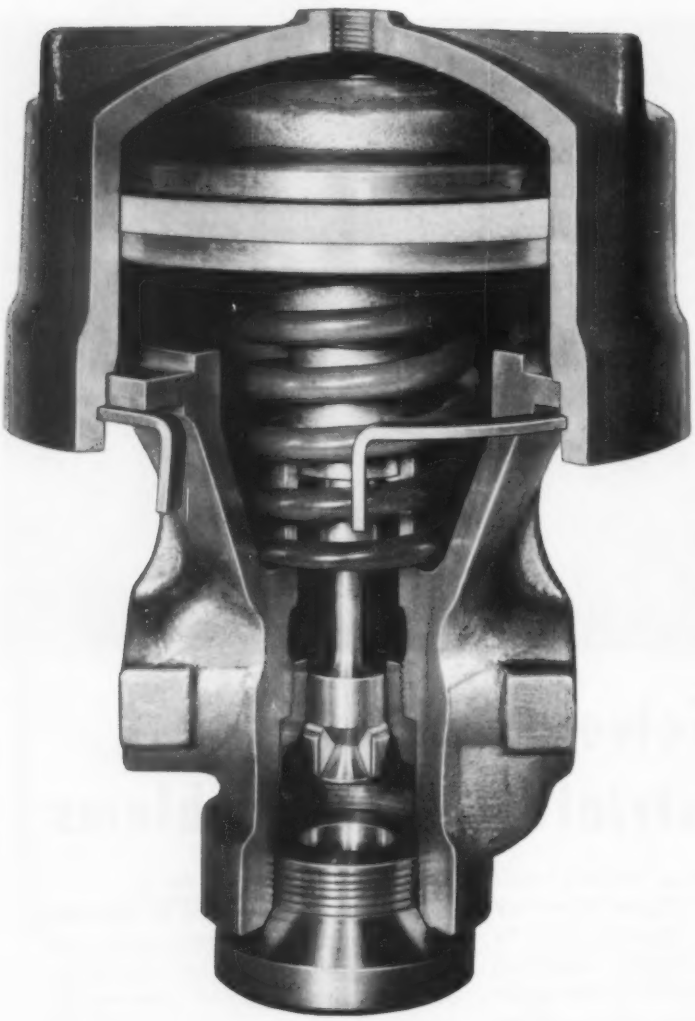

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Design and fabrication

(*From pp.* 133-142)

constant decreases slightly (and steadily) from about 5.0 at 1 kc. to 4.2 at 30 mc., while dissipation factor rises from 0.006 to 0.034 over the same interval of frequency.

Coefficient of thermal expansion ranges from 8.4×10^{-6} to 22×10^{-6}, depending on the type of orientation and the direction of measurement, in the temperature interval from −30° to 200° F. Thermal conductivity of the isotropic laminate increases slightly from 2.33 B.t.u./hr.,ft.^{2},(° F./in.) at 36° F. to 2.40 at 186° F.

These values may vary slightly, depending on the curing agent used, but they may be considered typical.

Design and production

Nagging at every designer's mind is the realization that his "baby" must be produced. Just as a metal-products designer would not design a hole that could not be drilled, bored, punched, burned, or cast, neither does the successful plastics engineer design a plastic part that cannot be economically manufactured. In order to be a truly useful engineering material, the reinforcing filaments which have been discussed must be furnished in a form which can be readily handled. To this end the glass filaments are provided in a matrix of moldable, uncured thermosetting resins which are then laminated to the desired thickness. This material satisfies the designer's need for predictable field performance, as well as the manufacturer's need for quick and reliable processing. Filament orientation is normally furnished in the unidirectional, crossplied, and isotropic forms already discussed, but specially tailored constructions are available. The directionally reinforced materials are available, uncured, in sheet form in a wide range of sizes and thicknesses; and in rolls, much like tape, for hand layup or spot reinforcement of areas of localized stresses. They are also obtainable in a cured state ready for machining or assembly either as sheets, bars, rods, angles, or other structural shapes.—END

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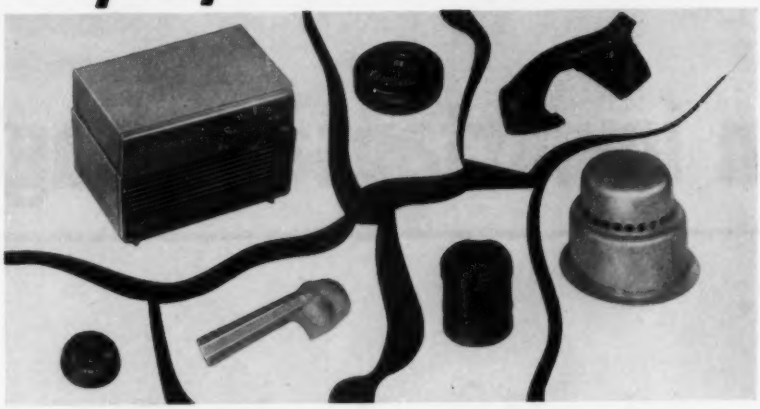

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Effect of gamma

(*From pp.* 180-186)

ylenedianiline, see *1* in Fig. 1, where presumably cross-linking forms rigid links between polymer chains as occurs in irradiated polyethylene; similar to the polyethylene case, percentage increase in hardness is high.

4) If relatively inert aromatic type curing agents are used, e.g., *m*-phenylenediamine and pyromellitic dianhydride, see *6*, *7*, *8*, and *9* in Fig. 1, epoxy plastic is highly radiation resistant and little or no change occurs in hardness. In addition to being radiation stable at least up to a gamma ray dosage of 10^8 r., epoxy plastic compositions made with pyromellitic dianhydride were the hardest compositions that were obtained in the course of the present investigation.

Heat distortion: It appears, Fig. 2, p. 184, that heat distortion properties of most epoxy plastics compositions are substantially unchanged on irradiation up to at least 10^7 roentgens. At 10^8 r. heat distortion temperatures are slightly decreased. The outstanding properties of epoxy plastics cured with pyromellitic dianhydride again are quite apparent, as evidenced by high heat distortion temperatures obtained in this investigation, i.e., about 500 to 575° F. as compared to about 200 to 300° F. for the other epoxy compositions.

Compression strength: A highly selective pattern of improvement was noted, Fig. 3, p. 186, for effect of radiation on compressive properties of epoxy plastics. Increases percentage-wise were small (0 to 7%) in all cases. The highest compressive strength was found in formulation *9* containing *m*-phenylenediamine as the curing agent. The degree of improvement by radiation was also among the highest for this composition. Specimens containing pyromellitic dianhydride apparently were so hard that the test cylinder was shattered during the compression tests; the force was so violent that pressure gage readings were invalidated.

Several attempts were made to polymerize epoxy resins with curing agents present using radiation alone in place of heat. Though several rigid plastic compositions were obtained in this way, it was deemed impractical as a method *per se*, since properties were inferior to those obtained using either ordinary thermal curing or post radiation curing methods. The most successful radiation curing was achieved when reactive diluents, containing active vinyl groups, were present. Presumably, radiation curing alone results in a smaller polymer molecule due to the fact that the curing agents polymerize by condensation reactions which are not radiation promoted as are vinyl polymerization reactions. The relatively high radiation resistance exhibited by the epoxy compositions also would tend to inhibit radiation curing.

The authors wish to acknowledge the help rendered by Dr. R. H. Shudde of this laboratory for his part in the initial phases of this investigation.—END

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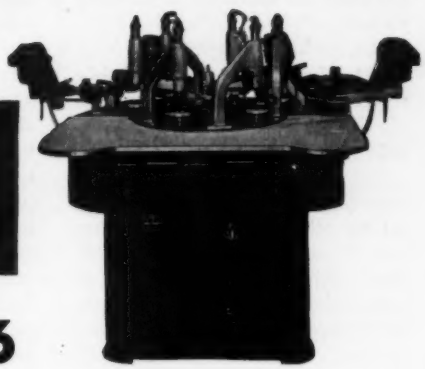

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 35)*

Progress in Delrin

A tiny star in the plastics firmament called Delrin is about to grow brighter. It was first detected late last year (see MODERN PLASTICS *34*, 258, January 1957), but it has attracted little notice because of lack of information on its behavior. It will be a long time, perhaps 1965, before its brilliance equals that of other stars in the plastics galaxy, but then, as a molding and extrusion material exclusively, it may outshine them all.

A considerable amount of experimental work has already been done with pilot plant quantities. Du Pont, the producer, is showing pictures of specimen molded parts that have been in service for from one to three years but probably won't have commercial quantities of the material available until 1959 or 1960.

Delrin has one potential property that is more intriguing than all its other fine qualities. That one is spelled P-R-I-C-E. Du Pont officials will take no part in any discussion on possible price; they merely state that its beginning cost will probably be around $1, with a less-than 80¢ price shortly afterward. Observers believe it will eventually drop much lower. It is called an acetal resin and is derived from formaldehyde. It was once believed not possible to polymerize formaldehyde for any useful plastic purpose, but Du Pont has done it. Formaldehyde, at between 10 and 11¢/lb., is one of the lowest-cost monomers used in plastics. Raw material price is, of course, not the only factor in production costs, but it helps to have it low.

* Reg. U.S. Pat. Off.

Thousands of uses. Delrin is in no sense a miracle material that will do everything. Like wood, steel, aluminum, rubber, leather, glass, and other plastics, it has limitations. No one is going to build a Delrin house or automobile, but design engineers are going to find a place for it in thousands of applications. By 1965, it will probably be a component part in hundreds of machines and be widely used in housewares, hardware, and other industrial items. Nothing has so far been released concerning its uses in other than molding and extrusion applications.

But so far as molding materials are concerned, Du Pont laboratory technicians claim that actual use tests show that Delrin is less affected in strength, stiffness, and toughness by temperature than any other commercial thermoplastic. Particularly outstanding are strength and toughness at low temperature and strength and stiffness at high temperature. This high heat-distortion temperature permits design of lightweight parts for high-temperature use. It can be used in gasoline engine timing gears, cams, and bearings operating at 250° F. or freezer door hinges and ice tray dividers at sub-zero.

Under moderate loads at room temperature, Delrin exhibits creep resistance roughly comparable with other thermoplastics, but when subjected to high loads, prolonged loading, high temperatures or high humidity, the material is claimed to show a pronounced superiority over other thermoplastics.

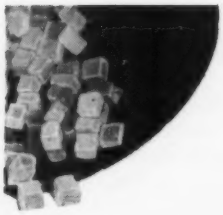
Properties maintained. In air, the physical properties of Delrin will be retained indefinitely in continuous service at temperatures up to 185° F. or in intermittent service at temperatures up to 250° F. Its moisture pick-up is virtually zero and in water it will retain its properties indefinitely at moderate temperature; it is suggested as a material for shower heads or dishwasher parts. In motor oil, Delrin acetal resin has been exposed at 212° F. for 2000 hr. with no significant change in physical properties.

Delrin has proved its toughness in use in automobile door-latch wedges, freezer door rollers, combs, clothes pins, and gears. Even a 2-lb. molded garbage can liner can be produced, but in big pieces, as with other molding compounds, maximum toughness is difficult to acquire because of the ever-present problems of molded-in stress, orientation, flow variations, and weld lines.

However, there are many kinds of toughness. In a mandrel bend test, a ⅛-in. bar of Zytel nylon can be bent 180 degrees around a ⅛-in. mandrel, but a similar bar of Delrin can be bent only 90 degrees around the same mandrel, although it can be bent 180 degrees around a larger mandrel. Thus Delrin is tough in the sense of strong and rigid, whereas Zytel is tough in the sense of resilient and should be used where the ability to yield with a blow is important.

Abrasion resistance. Delrin's abrasion resistance is sufficient to stand the wear of typewriter actuator cams, football shoe cleats, and chair caster wheels. It can be used without lubrication in bearings. Ultraviolet affects Delrin as it does many other thermoplastics; therefore, it must be filled with carbon black for out-of-door use. There are virtually no solvents for Delrin at temperatures under 160° F. It is stain resistant and apparently nontoxic. Its permeability properties are such that it may be used for aerosol bottles: cologne and shaving lather have stayed in a bottle for a year and still contained enough Freon propellant to discharge the contents completely.

There are many other points to the Delrin star. When its full



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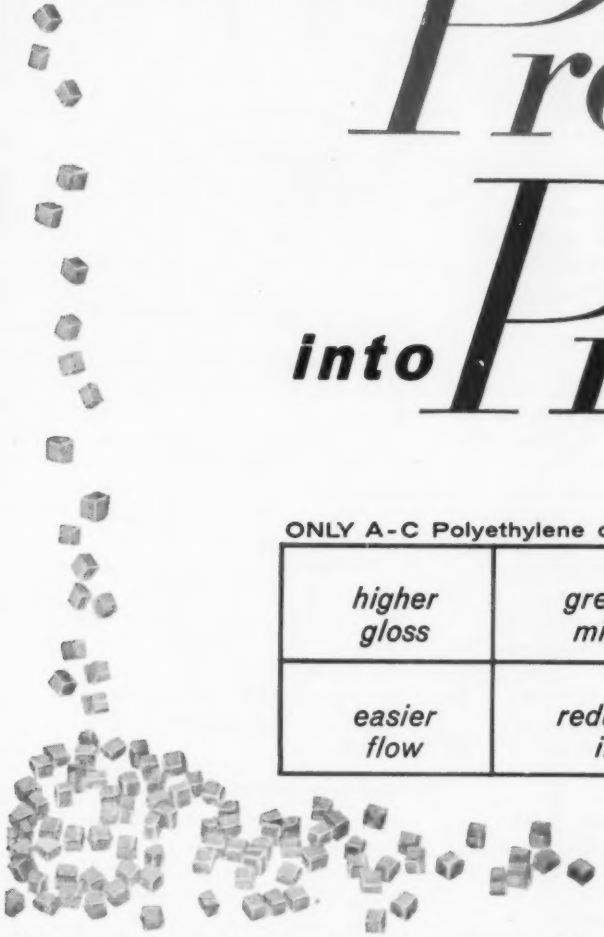

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luster has developed, Delrin will undoubtedly become the "shining light" in many a molding plant throughout the country.

Polymer symposium

The Plastics and Polymer Group of the Society of Chemical Industry will hold a symposium in London from April 15 to 17, 1958 on the general subject of the physical properties of polymers. Particular emphasis will be placed on recent advances in 1) the fundamental investigation of mechanical and electrical processes in polymers and 2) the physical testing of plastics, rubbers, and fibers, with special reference to dynamic and relaxation methods.

Papers from laboratories in any part of the world are invited. Papers on the flow behavior of polymers and on the long-term stability of plastics would be particularly welcome.

Offers of papers should be made to The Honorary Recorder, K. H. C. Bessant, The Distillers Co. Ltd., Great Burgh, Epsom, Surrey, England.

New method for treating film

The United States Government has granted Patent No. 2,802,085 to Modern Plastic Machinery Corp., Lodi, N. J., covering its new electro-contact method of surface treating polyethylene and other plastic films to render them receptive to printing inks. Additional U. S. patent applications are still pending. Called MPM-Rothacker Film Treater, the apparatus has already been patented in nine foreign countries and patent applications are pending in 25 others.

This new method is an ingenious application of electronic principles. Film is passed between two distinct sets of rollers, one large roller and a series of smaller covered rollers. One set carries a positive electrical charge and the other a negative charge. Since the material is in direct contact with the rollers at all times and high voltages are not required, no arcing takes place. Consequently, there is no corona discharge or formation of explosive or noxious gases. One simple control is provided as well as visual indicators so that the treatment is always uniform, maintainable and, with like settings, reproducible at any time with the same material. This applies not only to single layers, but also to gusseted or folded material, irrespective of the intensity or velocity of the treatment.

New wall sealer

A new paint and varnish sealer that eliminates the need for removal of paints and varnishes from wall surfaces before the application of Koroseal vinyl wall covering will be available soon in 1-gal. containers from B. F. Goodrich Co. The sealer prevents pigment bleeding of paint or varnish through the vinyl wall covering. Old wallpaper can also be treated with the sealer. This guards against bleeding-through of the printing inks in the paper.

Claiming to be the first in the industry to introduce a sealer specifically designed for vinyl-coated fabrics, BFG will market the product as Koroseal Vinyl Wall Covering Sealer A-904-B.

Cellular plastics

The production of cellular plastics amounted to about 16 million lb. in 1956, according to Dr. Paul G. Roach, chairman of the Cellular Plastics Div. of The Society of the Plastics Industry, Inc., and executive development engineer of United States Rubber Co., Mishawaka, Ind. For the current year, Dr. Roach estimates that production of the cellular plastics will reach approximately 29 million lb., or a 55% growth over last year.

It is estimated, according to Dr. Roach, that flexible and rigid vinyl foam production, which amounted to 3.5 million lb. in 1956, will more than double this year. Flexible and rigid urethane foam, which amounted to about 4.7 million lb. last year, should double production in 1957, said Dr. Roach. Rigid polystyrene foam production reached 8 million lb. in 1956 and production in 1957 will amount to 12 million lb., in Dr. Roach's estimation.

For a survey of present and potential uses of flexible and rigid foams, see MODERN PLASTICS, 35, 115, September 1957 and p. 124 of the present issue.

Plastics courses

Winter and spring courses in plastics are being offered by the Special Courses Division, Newark College of Engineering, 367 High St., Newark, N. J.

The winter term begins January 6, 1958. Registration for new students is from December 2 to 4, 1957; for former students from December 9 to 12, 1957. Possible courses include: Compression and Transfer Molding; Plastic Mold Design; Thermoplastic Process Techniques; Testing and Control of Plastic Properties.

The spring term begins April 3, 1958. Registration for new students is from March 24 to 26, 1958; for former students from March 31 to April 2, 1958. Possible courses include: Injection Molding; Thermosetting Process Techniques.

New type phenolic

Since trimethylolphenol was introduced by Bakelite a few months ago, it has aroused much more than the usual interest. Like many other new chemicals, it is being offered as a material with which chemists may experiment to develop new or improve older products. Bakelite technicians are not certain just where it will become most useful, but the company is confident enough of its future to have begun production on a commercial scale.

Trimethylolphenol has been known for a long time as a laboratory material. Now it is available as a monomeric commercial chemical and because of its high degree of chemical reactivity may become useful in the formulation of new resins and in upgrading the properties of other materials.

For surface treatment. Presently it is particularly suggested

Announcing

—FIBERFIL—

Nylon G2A

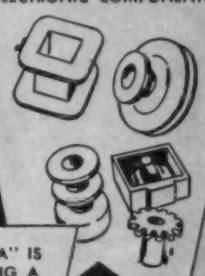
ANOTHER IMPORTANT ADDITION TO THE FIBERFIL FAMILY OF REINFORCED INJECTION MOLDING COMPOUNDS!

After thorough testing to establish outstanding electrical, chemical and physical properties — as is standard practice for all formulations developed by FIBERFIL — still another great new Nylon injection molding compound has proved a worthy addition to the growing list of *reinforced* FIBERFILS.

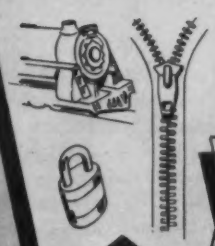
Its name is "Nylon G2A" and it's a true FIBERFIL from every quality standpoint. Heat distortion is high. Molding accuracy is exceptional, with shrinkage and warpage held to a minimum. And the *added* impact strength inherent in FIBERFIL "Nylon G2A" marks a further step forward to application opportunities that have been "out of bounds" for non-reinforced plastics.

These are but a few of this new FIBERFIL's characteristics that might well make it the answer to your next problem or project . . . that we'll welcome the chance to help you evaluate in terms of *your* requirements. Write for specific application data, or phone if you prefer. No obligation either way!

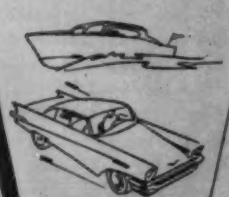
FIBERFIL "NYLON G2A" IS IDEAL FOR PRODUCING ALL ELECTRONIC COMPONENTS!



REINFORCED "NYLON G2A" IS JUST RIGHT FOR MOLDING A HOST OF HARDWARE ITEMS, NOTIONS, TOYS!



NEW "NYLON G2A" PERMITS SUCCESSFUL INJECTION MOLDING OF NUMEROUS BOAT FIXTURES AND AUTOMOTIVE PARTS!



Reinforced Insurance

FOR ALL INJECTION MOLDING!

FIBERFIL

FIBERFIL, Inc.

FOX FARM ROAD • WARSAW, INDIANA

The Plastiscope

for use in liquid resins, mostly of the water-soluble type, for surface treatment. In a laminating compound to be used with a cellulose fiber product, the new material will penetrate more thoroughly than present phenolics and give a surface that is harder and less susceptible to moisture penetration. It should initiate further interest as a building block for new compounds and in combination with other materials (including polymers) to produce a desirable property.

In laboratory tests it has been used instead of formaldehyde to form compounds with urea, melamine, polyamino compounds, polyhydroxy compounds, phenol, substituted phenols, two-step phenolic resins, resorcinol, and aniline.

Called BRLA-1030, it has a broad potential for use in industrial coatings, adhesives, impregnations, and plastics alloys. It is miscible with methyl alcohol, ethyl alcohol, and acetone. It will react as a one-step phenolic resin, slowly converting to a cured resin at room temperature. In the range of 150 to 160° C., it will harden in 80 to 100 seconds.

Potential applications. BRLA-1030 sells for about 35¢/lb. in the form of a 70% solution in water. Some of the applications for which it is being tried are:

1) As a vulcanizing agent for Thiokol rubber.

2) To improve the cure rate and lower water absorption in electrical-grade laminates.

3) To reduce water absorption in paper-base battery separators.

4) To improve impregnation of resin in wood.

5) To improve impregnation of paper honeycomb, although brittleness may result.

6) To permit greater range of sheet modification in thermal insulation.

7) To use with starch or sugar materials to help make them more insoluble in water and thus improve adhesive properties.

8) To upgrade adhesives used for adhering nitrile rubber to metal.

9) To make urea harder and more resistant to chemicals.

10) To make coatings based on starch which may be useful for fibrous sheet or boards.

11) To improve wet-strength of paper, but its dark color is a handicap.

12) To serve as a surface treatment in textiles.

13) To yield baked films exhibiting good adhesion to glass and good water resistance when used with polyvinyl alcohol, hydroxyethyl cellulose, or partially hydrolized polyvinyl acetate. It is also being tried as water-resistant sealer for porous board, cement, and bricks.

14) To denature proteins such as glue, collagen, and leather and make them less susceptible to solution in or swelling by water.

Many chemists are now becoming familiar with the possibilities and intricacies of the material. From their research it is quite possible that improved adhesives, resins for surface treatment, and improvement of resins already on the market will be achieved.

Labeling contest

The third annual contest for the best Informative Labeling for Plastics Products sold at retail has been announced by The Society of the Plastics Industry, Inc. The competition is open to all companies and individuals in the United States manufacturing or marketing consumer plastics products. Non-members as well as members of S.P.I. are eligible.

Entries, which may be labels, hang tags, inserts, packaging, etc., should be submitted to S.P.I. with the products they identify, when practicable. The contest, which will be judged by merchandising authorities and editors, closes December 1, 1957.

Awards will be made for informative labeling that tells the consumer what the product is, what it will do, what it is made of, how to take care of it, gives a brand name or other identification, and shows a guarantee (optional).

An award will be made in each of the following classifications: apparel, building materials, floor and wall coverings, hardware, home furnishings, housewares, notions, sporting goods, toys, and miscellaneous. A grand award, chosen from the winning entries in each classification, will be presented for the "Best in Show."

Entry blanks may be obtained from S.P.I., 250 Park Ave., New York, N. Y.

Plastics news from Hungary

Nearly half of the 137-mile Rumanian section of a pipeline that will carry methane gas to Hungary for use by its plastics industry has now been laid, according to an announcement by the Hungarian deputy minister of heavy industry. The pipe will carry 200 million cubic meters of gas annually.

The materials are required mainly for making PVC and polyacrylonitrile.

It was also announced that construction of a 75,000-lb. annual capacity polyethylene plant is nearing completion.

To sponsor lithium-polymerization research

In an effort to amass new technical information on the role of lithium and its compounds in polymerization reactions, American Lithium Institute, Inc. will sponsor a research program at Princeton University. The project will be under the direction of Professor Arthur V. Tobolsky, Department of Chemistry.

Lithium and its compounds will be used experimentally as initiators and modifiers in vinyl polymerization and copolymerization.

Saran coating

A new lacquer coating material, saran resin F220, has been introduced by The Dow Chemical Co., Midland, Mich. The new product is differentiated from other saran resins by its low viscosity and complete solubility in acetone.

According to the company, F220 gives many packaging materials

U.S.I.

Vol. II, No. 5

POLYETHYLENE PROCESSING TIPS

HOW CARBON BLACK QUALITY AFFECTS WEATHER RESISTANCE OF POLYETHYLENE

For cable jacketing and many other outdoor applications polyethylene offers substantial advantages over other materials. It is subject, however, to degradation from long exposure to sunlight unless the resin is properly protected.

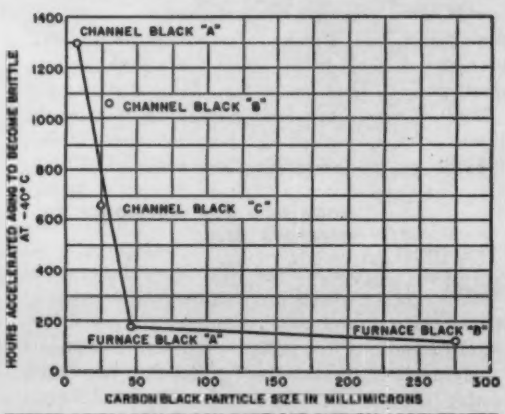
Actually, the aging of polyethylene is the result of a chemical reaction with atmospheric oxygen. Catalyzed by the ultraviolet rays in sunlight, this reaction proceeds more rapidly in outdoor use than is the case with indoor applications. The principal effects of aging are to increase brittleness at low temperature, and to decrease the resistance to stress cracking.

Carbon black dispersed throughout the polyethylene greatly retards this aging, or weathering. However, not all carbon blacks produce the same degree of weather resistance when dispersed in polyethylene. Moreover, the care with which the carbon black is dispersed in the polyethylene is vitally important.

The weather resistance of a polyethylene compound depends on: (1) type and particle size of carbon black; (2) percentage of carbon black in the compound; (3) the dispersion of the carbon black in the polyethylene.

Accelerated aging tests have been devised to approximate the action of years of outdoor exposure.

The graph below shows the great difference in number of hours required in these tests for a polyethylene to embrittle at −40°C when various carbon blacks having different particle sizes are used.



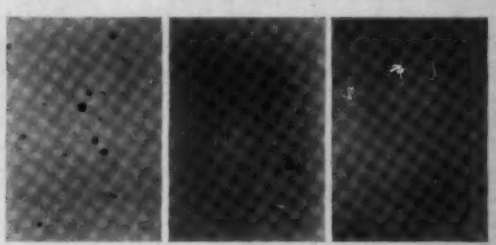
EFFECT OF CARBON BLACK PARTICLE SIZE ON ACCELERATED AGING OF POLYETHYLENE.

The two at right are "furnace blacks", and it will be noted that they are comparatively ineffective. The three at the left are "channel blacks", and obviously, they are many times more effective. This is due to their much smaller particle size — from about 10 to 25 millimicrons, against 50 to 275 millimicrons for furnace blacks.

Weather resistance also increases with the concentration of carbon-black — up to a point. Beyond this point the light screening effect is offset by a decline in other properties.

DEGREE OF DISPERSION IMPORTANT

Carbon black gives maximum protection only when it is thoroughly dispersed in the polyethylene. This presents a difficulty because the smaller the particles, the greater is their tendency to collect into clusters which, once formed, are hard to break up. Tests show that a good dispersion will withstand 15 to 20 times as much exposure to sunlight as a poor dispersion.



MICROPHOTOGRAPHS OF CARBON BLACK DISPERSIONS IN POLYETHYLENE.

The wire and cable grades of U.S.I.'s PETROTHENE polyethylene resins employ only the finest "channel black" carbon black. Concentration is set at a point which yields the optimum balance of light screening and other properties. Special processing equipment insures thorough dispersion. The result is black polyethylene that withstands long, severe outdoor exposure, yet affords the practical maximum of tensile and other properties.

If you fabricate or use black polyethylene, ask U.S.I. for complete technical data on PETROTHENE resins expressly formulated for weather resistance.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.
Branches in principal cities

The Plastiscope

significantly reduced moisture vapor transmission and gas permeability, and increases oil and grease resistance, flavor retention, and abrasion resistance.

Saran resin F220 is particularly recommended for coating paper as well as polyethylene, cellophane, and polyester films. It gives polyethylene film greater clarity, improved gloss and slip, and gives improved chemical resistance to a wide variety of packaging materials. Coatings formed of F220 are heat sealable.

Monsanto polyethylene meets MILs

Coaxial cable manufactured with Monsanto Chemical Co.'s polyethylene formulation 12253 will meet the requirements of MIL-C-17B specifications, according to a company announcement. The formulation also conforms to MIL-D-3054A, which specifies the requirements for polyethylene dielectric material used in the manufacture of radio-frequency cable.

The material is suggested for insulation on telephone and power as well as coaxial cables. Other compositions offered by Monsanto include 11302 for weatherproof line wire and service drop; 14202 for telephone cable jacketing; and 12203 for telephone primary insulation where increased resistance to deformation is needed.

Light-stable polystyrene

Development of a new light-stable styrene polymer for injection molding and extrusion has been announced by Monsanto Chemical Co.'s Plastics Div. Designated Lustrex Perma-Tone, the material is a special formulation with strong resistance to discoloration after prolonged exposure to fluorescent light.

The material is specially recommended for use in lighting fixtures, including egg-crate louvers, side panels, and extruded light diffusers. Other suggested applications include decorative panels, clock lenses, dial faces for radios and clocks, washing machine escutcheons, and other consumer goods which are routinely exposed to fluorescent light.

Lustrex Perma-Tone is available in translucent or opaque colors. Its physical properties are said to be comparable with those of other general-purpose styrene molding materials.

Molds for prototypes

Plastics and rubber parts and products for experimental engineering purposes can be produced at low cost by the Kotokast process, a technique developed by Minnesota Rubber & Gasket Co., Minneapolis, Minn. The process is based on low-cost materials from which molds can be quickly made that are satisfactory for short-run prototype production but not necessarily suitable for normal production runs. The original objective was to make molds which would produce 12 satisfactory parts; however, as many as 100 parts can now be produced. Technical details on the process are not availab!e for publication.

Cost savings cited by the company include the following examples: An O-ring, required in limited quantity, was produced at a cost of $25 for 12 prototype parts; tooling cost by standard methods would have been $54. A prototype boot of complex shape, intended for a development project, was estimated at $2900 for standard tooling costs. It was produced by Kotokast for $450.

Anti-oxidant

A low-melting anti-oxidant, produced by Catalin Corp. of America and designated AC-6, is claimed to provide (in low concentration) effective and economical protection of polymeric materials against oxidative degradation at high temperatures. It is available in pilot plant quantities.

The company states that low melting range of the material facilitates its incorporation in polyethylene, impact grades of polystyrene, waxes, petroleum hydrocarbons, rubber, and other materials in which high temperatures are a factor in processing and in end use.

AC-6 is said to be non-staining, non-discoloring, and of low toxicity.

Short run service for wire and cable

Alpha Wire Corp., 200 Varick St., New York, N. Y., has instituted a short-run department to assist development and prototype work in electronic wire and cable. The department is specifically geared to process wire and cable for cutting, stripping and tinning, striping, braiding, cabling, jacketing, shielding, marking, numbering, and special color coding.

These exclusive "short-run" services apply to any Alpha in-stock item (of which there are over 2000) and to special construction wire and cable.

High-density polyethylene sheets

Joseph Davis Plastics Co., 450 Schuyler Ave., Arlington, N. J., announces that it has available for study and in product development quantities vacuum or drape formable sheets of the new high-density polyethylenes.

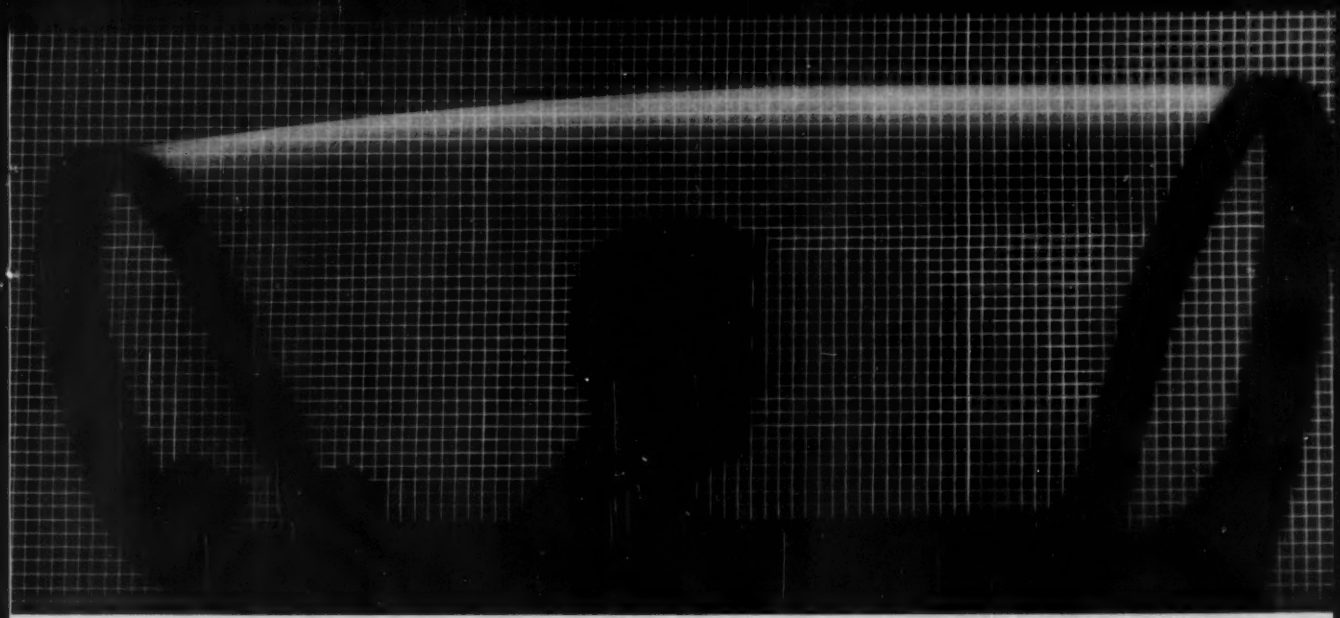
Present sheets are 22 in. wide, but the firm can produce them up to 36 and 42 inches. The materials are available in gages from 0.0075 to 0.060, and in colors as well as translucent.

Products for which the material is being studied are tank linings, bakery trays, fish, shrimp and other food packaging, instrument packaging, hospital applications, and lighting fixtures.

Know-how for machinery to overseas firms

A package offer of machinery and consultant engineering service to overseas business groups interested in the manufacture of structural plastics panels has been made by Resolite Corp., Zelienople, Pa., U. S. producer of such panels.

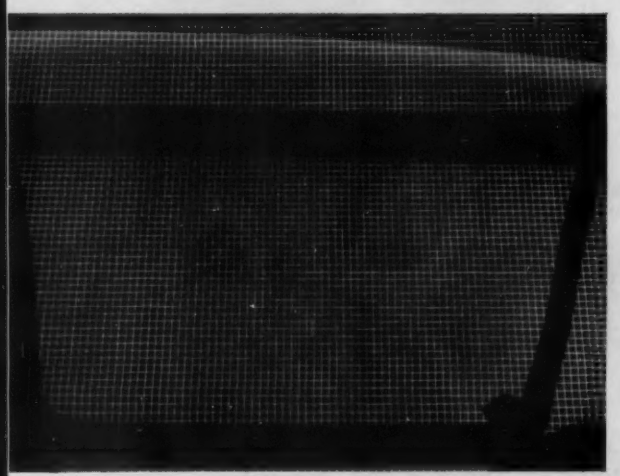
The package deal includes shipment of an automatic lami-



Republic F-105 canopy in front of standard test acceptance grid. Any defect in optics would result in distortion of the grid lines. Note that the Swedlow stretched acrylic Republic F-105 canopy, in a compound contour shape is virtually distortion-free.

Above: View through two sides of canopy.

NOW! SWEDLOW "STRETCHED ACRYLICS" PROVIDE GOOD OPTICS ON REPUBLIC F-105



View through one side of canopy only.

Now... on a "production basis"... aircraft canopies and windshields in compound contours are being fabricated of Swedlow stretched acrylic materials... with good optics.

SWEDLOW "STRETCHED ACRYLICS" HAVE AMAZING PROPERTIES

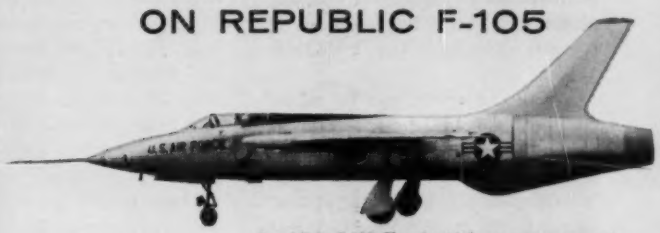
Stretching of acrylics has been a Swedlow-sponsored development over the last few years. The process involves the *molecular rearrangement* of acrylic sheeting by *appreciable* mechanical stretching.

Results:

Excellent Optics and Visibility	*Higher Resistance to Stress Crazing*
Greatly Improved Toughness	*Reduced Notch Sensitivity*

Swedlow offers highest quality workmanship and service, reliable delivery performance, technical expertness in formulating and fabricating plastics.

For full information, write today!



Republic's F-105 Thunderchief, newest supersonic fighter-bomber developed to deliver nuclear weapons and heavier loads of conventional bombs and rockets at extremely high speeds over long ranges, feature Swedlow-produced stretched acrylic canopies and windshields.

The F-105 encompasses such outstanding design features as the long, cylindrical fuselage, the short, very thin swept-back wings, the needle nose, and the ventral fin on the bottom of the aft fuselage near the tail. Design based on Area Rule. Wing span, over 30 ft. Length, over 60 ft. Powered by Pratt & Whitney J-75, 15,000 lb-thrust class, turbo-jet engine plus afterburner. Speed—supersonic.

Careful, technically accurate efforts go into the fabrication of each Swedlow stretched acrylic part. Republic F-105 canopy being fabricated in Swedlow plant.

Windshield on Republic's F-105, as on many other fighters and bombers, is also of Swedlow stretched acrylic... produced on a "production basis"... with *good optics and contour.*

Los Angeles, California

Youngstown, Ohio

Please refer to Dept. 15

Swedlow
PLASTICS COMPANY

nating machine for impregnating glass fiber mats with resin to form the panels, engineering details on other necessary plant equipment and production methods, and one year's technical consultation service on fibrous glass-plastic panel manufacture.

New coatings for polyethylene

Two new external coatings for polyethylene containers, Hi-Gloss and Barrier Gloss, have been announced by Bradley Container Corp., a subsidiary of American Can Co.

Hi-Gloss, a varnish coating, when applied to polyethylene imparts a high sheen which deepens and sharpens label colors. It is said to also eliminate static and provide a tough, durable finish that prevents scratches, scuffing, and other signs of wear.

Barrier Gloss gives natural polyethylene a glass-like clarity. The company reports that its new coating also helps to reduce permeation of essential oils and slows down the transmission of oxygen through the container walls.

Screening agents can be added to both coatings during fabrication and can be used with or without the special internal coatings introduced by the firm several months ago to improve the shelf life of many products packed in its tubes and bottles.

Equipment distribution

Rainville Co., Inc., Garden City, N. Y., in a major expansion program to increase its sales coverage of equipment to the plastics industry, announces the opening of three new district offices, the appointment of three sales organizations as representatives, and the addition of personnel to existing offices.

The new district offices are: New England office at 114 Fenwick St., Framingham, Mass., with Nicholas Gerten as district manager; Ohio office at 100 Victor St., Dayton, with F. L. (Jack) Miller as district manager; and Michigan office at 28700 W. 8 Mile Rd., Farmington, with Hal Fisher as district manager.

Royal E. Fisler Co., 225 Baker St., St. Louis, Mo.; Sterling & Newby, Inc., 4431 Maple Ave., Dallas, Texas; and R. R. Walters & Associates, 1016 Plymouth Ave. N., Minneapolis, Minn., have been appointed sales representatives.

The following appointments were made to existing offices: Allan Niebuhr, formerly with Rainville's Abington, Pa., staff, is now field engineer for the northern New Jersey territory; Fred Mears assigned to the New York office; Charles E. Worden named field engineer at the Franklin, Pa., office; and Richard Moses is manager of extruder sales, working out of the Alhambra, Calif., office.

The company now has 12 sales offices serving the entire country.

High styrene resin down

A general price reduction on high styrene resin, representing a savings of 3¢/lb., has been announced by Marbon Chemical, Div. of Borg-Warner Corp., Gary, Ind. The price cut applies to the company's complete line of rubber reinforcing resins.

These friable granular powders, which are compatible with natural rubber, styrene rubbers, nitrile rubbers, and Neoprenes, provide increased hardness, modulus, abrasion and tear resistance, and better electrical properties; and in styrene and nitrile, improvement in tensile strength and elongation. Some typical compounds dependent upon these properties are used for shoe soles, rubber floor tile, electrical cable and insulation, synthetic ebonite, grommets and washers, and leather- like rubber.

Polyethylene filament

A monofilament made of low-pressure-processed (linear) polyethylene has been announced by Firestone Plastics Co., Pottstown, Pa. Designated Velon LP, the new product is reportedly suitable for webbing for outdoor furniture, and broad fabrics for casual upholstery and automobile seat covers.

Color stability is claimed to be good. The company states that some colors have withstood up to 1500 Fadeometer hours with no sign of change. (See "Polyethylene fibers face brighter future," MODERN PLASTICS 34, 132, December 1956.)

Fluorocarbons

Teflon-lined pipe. Corrosion-proof lined steel pipe and cast-iron fittings, designated Fluoroflex-T-S, have been announced by Resistoflex Corp., Roseland, N. J. The pipe, lined with Fluoroflex-T1001 Teflon compound, is intended for use by the chemical industries especially to handle any and all hot acids, including hydrofluoric aqua regia, and caustics in applications where high temperatures and/or pressures accelerate corrosion.

Fluoroflex-T1001 is said to be chemically inert at temperatures up to 500° F., except for molten alkali metals and fluorine at elevated temperatures and pressures.

Teflon tape in colors. Designed for application coding and identification, Teflon tape in thicknesses of 0.001 through 0.125 in. is now available in 10 colors from The Polymer Corp. of Pennsylvania, Reading, Pa. The tapes are said to meet the requirements of NEMA and military specification MIL-STD-104.

Tradenamed Polypenco, the tape is said to have a dielectric constant of 2.0 and volume resistivity of 10^{15} ohm-cm.

Copper-clad Teflon. A line of Chemelec copper-clad Teflon sheets and tapes for printed circuit and cable strip applications is being offered by Fluorocarbon Products, Inc., Div. of United States Gasket Co., Camden, N. J. Unlike previously used Teflon-impregnated glass cloth which, due to its weave, seldom provided a uniform dielectric constant over a given area and was subject to delamination, this new

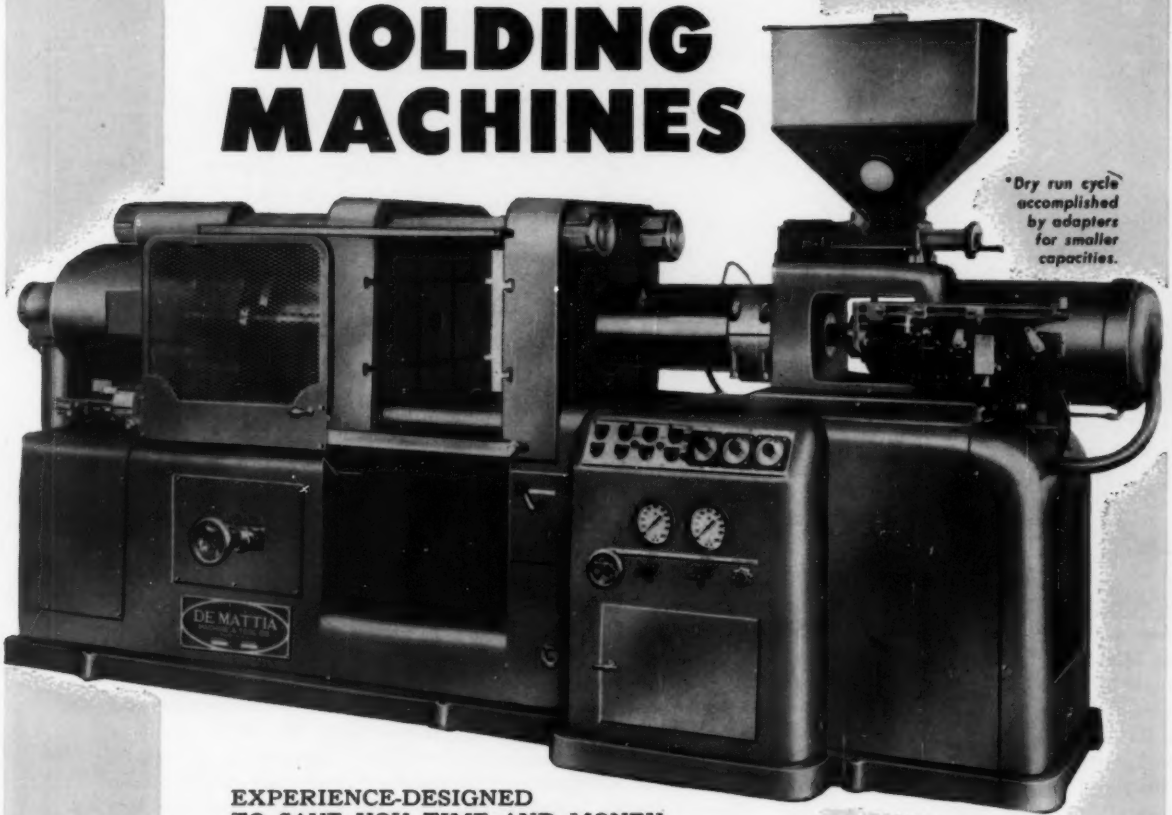
NOW—improve your molding production!

—WITH THE SENSATIONAL NEW

DE MATTIA
SERIES M
MOLDING MACHINES

- IMPROVED DESIGN
- FULLY HYDRAULIC OPERATION
- UP TO 6 CYCLES PER MINUTE*
- 16 OUNCES BY AUTOMATIC PRE-PACKING

*Dry run cycle accomplished by adapters for smaller capacities.



EXPERIENCE-DESIGNED TO SAVE YOU TIME AND MONEY

the new Model M Molding Machines are another step forward in molding production. These high efficiency injection machines help you meet competition... are expressly designed to increase your molding production and cut your molding costs. Series M machines offer fully hydraulic operation, up to 6 cycles per minute on smaller shots and shots up to 16 ounces by means of automatic pre-packing!

Available in 8 and 12 oz. Models. The De Mattia Line also includes 4 oz. Verticals, 4 oz. Horizontals and Various Models of Scrap Grinders. Write for Illustrated Bulletins.

DE MATTIA MACHINE and TOOL CO.

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CLIFTON, N. J. • N. Y. Sales Office: 50 Church St. • Cable Address: Bromach, N. Y.

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solid Teflon material is said to assure a uniform dielectric constant and no delamination.

Copper-clad sheet is available 18 in. wide by 36 in. or 150 in. long, in Teflon thicknesses of 1/16, 1/8, and 3/16 in., with 1- or 2-oz. copper on both sides. Copper-clad tape 12 in. wide by 36 in. long is available in seven thicknesses of from 0.005 to 0.060 in., with 1-, 2-, or 3-oz. copper on one or both sides, or with copper on one side and a cementable surface on the reverse side.

Teflon rod, tubing, sheet. Extruded Teflon rod and tubing are now being produced by Chicago Gasket Co., 1271 W. North Ave., Chicago, Ill. Teflon rod is available in 21 stock sizes up to 2-in. diameter, and larger diameters on special order. Standard rod length is 6 feet.

Teflon tubing is offered in 10 stock sizes ranging from 1/4-in. I.D. and 1/2-in. O.D. to 1-in. I.D. and 1 1/2-in. O.D. Tubing of non-stock dimensions can be supplied.

The company also carries a line of Teflon sheet and tape.

Thin-wall Teflon spaghetti tubing. Microthin Teflon tubing, produced by W. S. Shamban & Co., Culver City, Calif., is claimed to be the thinnest wall Teflon tubing marketed so far and competitive with vinyl spaghetti tubing. According to the manufacturer, properties of the heavier wall tubing are retained.

Applications are expected to include use in light aircraft and missile components and in the chemical and medical fields.

Produced in the standard color coding range, the tubing is available in wall thicknesses from 0.005 to 0.010 in., AWG sizes #30 through #0.

Winding Teflon. Glass-base Teflon in widths from 20 to 40 in. and unsupported Teflon in 12-in widths are now being wound at Continental-Diamond Fibre Corp. Newark, Del., on new equipment designed by Hobbs Mfg. Co. The operation is conducted within a range of 5 to 30 ft. per minute. Tension, depending upon the individual job, ranges from 2 to 3 lb./in. of material width. Maximum roll weight allowance is 250 pounds.

Reinforced plastics

To make building panels. Formation of International Plastics Corp., Branford, Conn., has been announced. The firm will manufacture translucent, colored fibrous glass-reinforced polyester building panels.

Designated IPCOR, the panels are designed for functional or decorative use either indoors or outdoors by professional builders as well as do-it-yourselfers. They are available in several sizes; in three finishes—smooth, textured, and frosted; and in a range of five colors.

International plans to distribute IPCOR panels entirely through lumber and building supply wholesalers to retailers located in the New England region. Sale of the material to builders and architects outside of the northeastern states will be made with orders being placed through New England wholesalers.

Robert Alling is president; Stanton D. Barker, sales manager. Eric Olson, plastics consultant, has been retained to advise on matters affecting design and production and to conduct a continuing research program.

New fabricator. Laminair, Inc., Gardena, Calif., has been recently formed and will specialize in aircraft and missile structural and radio-frequency fibrous glass-reinforced plastics laminates. The company has tooling and production facilities available for work in polyester, epoxy, phenolic, and silicone resins.

John Love, formerly chief engineer and director of the Technical Services of Paul Omohundro Co., is president of the new firm; F. R. Schwend, previously product development engineer of Omohundro, is vice president; Stanley Harkins, sales manager, comes from Electromation Co., where he was assistant to the president.

Expansion

Chas. Pfizer & Co., Inc., 630 Flushing Ave., Brooklyn, N. Y., has acquired **Morton-Withers Chemical Co.,** Greensboro, N. C., producer of chemical specialties for the plastics, petroleum, and rubber industries.

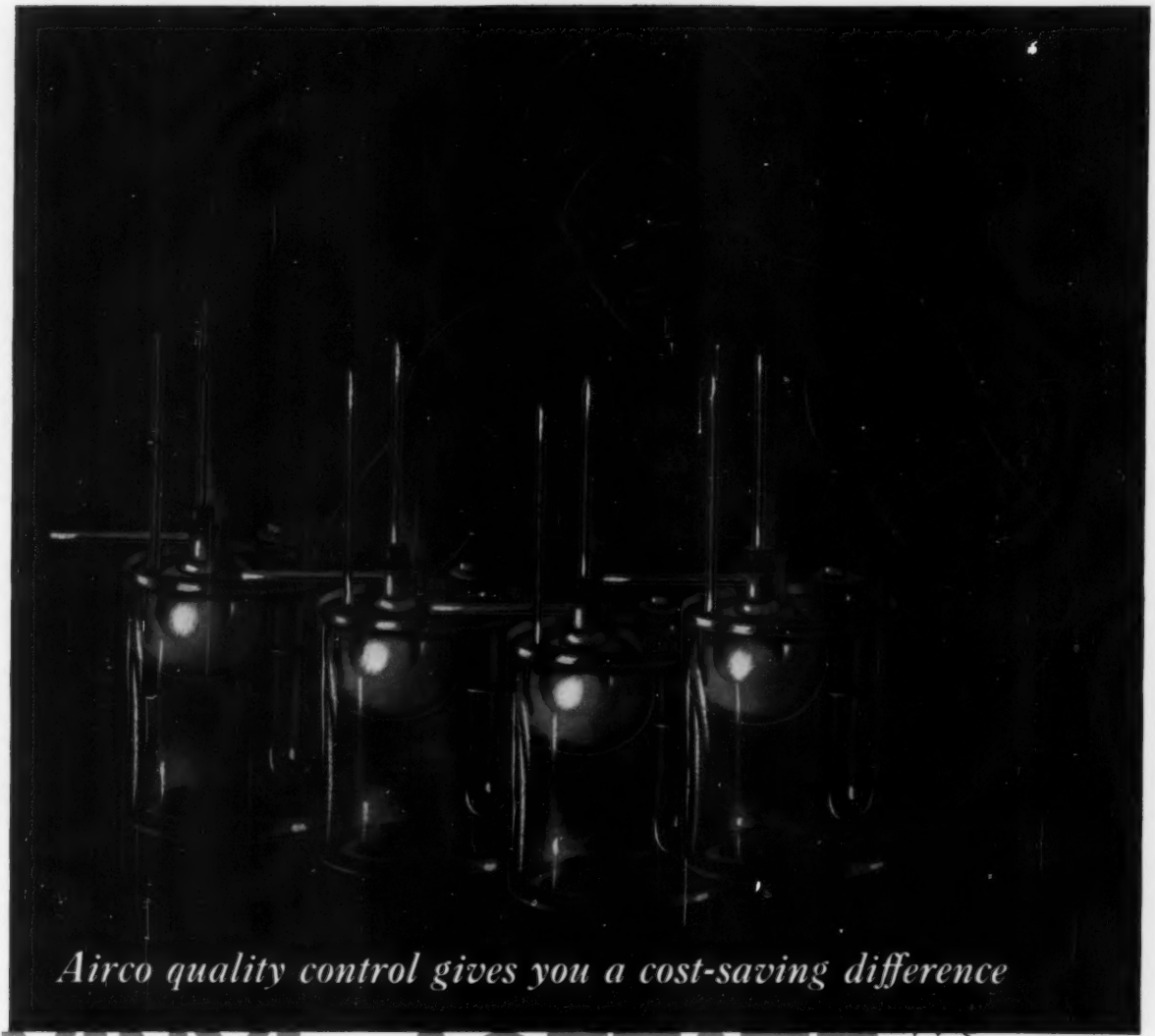
Morton-Withers will be operated as a subsidiary of Pfizer with no changes planned in management or personnel. **Joseph R. Morton** will continue as president and **John P. Withers** as vice president.

Sparta Mfg. Co., Dover, Ohio, is enlarging its facilities for coating metallic and non-metallic parts with Teflon. The new plant will have an additional area of 5000 sq. feet. It will be equipped with completely air conditioned dip rooms so that humidity and temperatures can be accurately controlled.

The TapeMark Co., St. Paul, Minn., printer-converter, has purchased **Thomco Mfg. Co.,** San Francisco, Calif., which holds basic patents on printing presses of the type used by TapeMark to print pressure-sensitive tapes and plastic films. TapeMark prints or combines pressure-senitive tapes, plastic films, and foils for use in package wrapping and as labels or markers.

The Thomco purchase is the second acquisition in recent years by the St. Paul company. In 1955 it bought **National Tape Co.,** Sioux Falls, S. D., and moved the entire operation to the St. Paul location.

Arvin Industries, Inc., Columbus, Ind., is expanding its facilities for the production of vinyl-metal laminates. Additional space in the firm's Hutchins plant is being provided for Arvinyl operations and new equipment has been ordered. Including in this equip-



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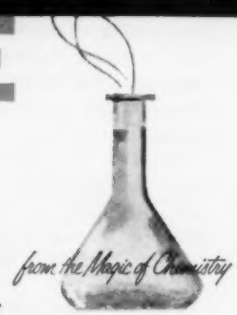
VINYL ACETATE MONOMER



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ment is a 70-ft. convection-type gas-fired oven which will replace the original experimental unit that has been used since Arvin first started developing vinyl-metal laminates.

Vinyl is now being applied to steel, and aluminum in sheet form only but plans are being made to provide for continuous application of the plastic to coils of the two metals.

The company is currently laminating and fabricating vinyl-metal laminates for television and radio cabinets, display cases, a variety of case goods, and automobile interiors.

United States Gasket Co., Plastics Div. of Garlock Packing Co., has placed into operation a new extrusion plant at Camden, N. J. Products being produced at the new facility include nylon rod in diameters up to 3 in.; nylon sheet and tape, 12 in. wide, in thicknesses from 0.002 to ⅛ in.; and nylon pressure tubing in diameters from ⅛- to ½-in. OD.. in two types—for 1000 p.s.i. and 2500 p.s.i. service.

The Dow Chemical Co. announces that construction of an acrylonitrile plant is scheduled to begin early next year at its **Texas Div.** at Freeport. The new facility, currently planned for completion in December 1958, is expected to start production during the first quarter of 1959. Acrylonitrile will be among the first Dow chemicals to stem from acetylene. Dow uses acrylonitrile for its Styrex copolymer and in a new fiber.

Reichhold Chemicals Inc., announces that its Azusa, Calif., plant has gone on stream with production of phthalic anhydride. Capacity of the Azusa plant will be 10 million lb. of phthalic anhydride annually.

Narmco, Inc. announces that construction is under way on the first phase of a $1 million industrial research and development center on a 10-acre site at 8125 Aero Dr., San Diego, Calif. The new three-unit layout will provide space for chemical laboratories, engineering, fabrication, and testing of structural adhesives, reinforced plastics, and sandwich-type structures for aircraft and commercial industries.

Completion of the laboratory is scheduled for December 1957 and will replace present facilities at 1882 Moore St., San Diego.

Wallace Silversmiths, Ltd. of Canada has acquired **General Plastics, Ltd.,** Toronto, Ont., manufacturer of various items of plastics houseware and Melmac dinnerware.

Plans are being made to expand the General Plastics line. Some of this expansion is planned for Cookshire, the home of Wallace Silversmiths, Ltd.

Orangeburg Mfg. Co., Inc., Orangeburg, N. Y., and Newark, Calif., has acquired 3½ acres of

for plastics and resins

90 plants

20 products

1 builder

Blaw-Knox, pioneer in the industry, sets the pace in designing and building plants for polymer and resinous compound production.

Blaw-Knox has led for twenty-five years in plant development for products ranging from condensation polymers such as alkyds and polyesters to addition polymers including synthetic rubber, polyvinyl chloride and polyvinyl acetate. Blaw-Knox construction parallels the mushrooming growth of the industry.

Blaw-Knox unexcelled know-how will pay off on your next project. A complete service is available—from preliminary planning to initial operation. Contact Blaw-Knox for details.

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The Plastiscope

plant site and 40,000 sq. ft. of manufacturing facilities in Marion, Ind., from **Lynch Corp.**, Anderson, Ind., and will expand production facilities for its new Orangeburg SP plastic pipe.

Installation of manufacturing facilities is expected to be completed within six months; production of Orangeburg SP plastic pipe at the new plant will supplement that of its main plant at Orangeburg, N. Y.

Plastylite Corp., 333 North Dr., N. Plainfield, N. J., has added a new wing to its plant facilities which will increase the company's extruding and compounding capacities.

Adolph Sdebel has been named general plant superintendent.

General American Transportation Corp. has completed a new $750,000 plastics research laboratory at its East Chicago, Ind., plant. The new facility is equipped to test all types of existing plastics materials as well as to develop new types and determine additional uses for plastics compounds now in use.

The laboratory is divided into three basic areas: a physical testing lab, a reinforced plastics section, and a thermoplastics area. It was in this latter section that the company developed a new type of plastic wall plank for use in homes and offices. Production is scheduled to get underway in the near future.

B. F. Goodrich Chemical Co. announces plans for the expansion of headquarter facilities with the leasing of a 3-story building at 3198 Chester Ave., Cleveland, Ohio. The structure, comprising an area of about 28,000 sq. ft., is on property adjacent to BFG Chemical's new general offices at 3135 Euclid Ave. The first two floors of the new building will house Cleveland district sales offices, engineering groups, a textile laboratory, and other offices of BFG Chemical. About 55 people will occupy the building at the start. Occupancy is scheduled for the end of November.

John L. Doré Co., 5406 Schuler St., Houston, Texas, announces a $250,000 expansion program which will virtually double facilities of the Doré firm and its affiliated companies. The program will provide additional facilities and equipment for extruding and compression molding of Teflon sheets, rods, tubes, film, gaskets, and packing. It will also provide additional facilities for **Doré Linings, Inc.**, producer of Teflon-lined steel pipe and fittings, extruded and molded nylon, and other thermoplastics, and the parent companys' sales organization.

Officers of the firm are: **John L. Doré**, president; **Vivian Leatherberry Smith**, vice president; and **J. S. Bawcom**, vice president and general manager. **L. H. Calahan** has been named district sales manager of the company's new northeastern section, with offices in New York City.

National Adhesives, Div. of National Starch Products, Inc., has consolidated its Development and Technical Service Depts. which will operate as the Technical Development Div. at the Plainfield, N. J., laboratories. **Ralph McGaffin**, manager of the new division, stated that today's adhesive problems tend to be highly specialized and often require development of a new product. As a result, the new technical group has been set up in pairs, each consisting of a service engineer teamed with a formulating chemist.

Within the Technical Development Div., **William Sederlund** has been named manager, Packaging Adhesives, Technical Development, assisted by **Carl Witzmann** who will have primary responsibility for resin emulsions and hot melt products; **Richard Weidener** will be concerned with vegetable-based materials, dry dextrines, and extended resins; and **Jules Sirota** will be responsible for the investigation of longer range problems and projects. To provide similar coverage in the midwest, **Chris Fazioli** has been appointed midwest manager, Adhesives Technical Development, with headquarters at 3641 S. Washtenaw, Chicago, Ill.

An entirely new group has been set up to intensify National's interest and participation in the field of new product development. **Sam Gold** has been made manager, Technical Market Development, with headquarters at Plainfield; he will be assisted by **William Blake** as supervisor for the Eastern Adhesives Div.; **Robert Pett**, Midwest Adhesives Div. **Joe Ducharme** will coordinate all adhesive technical development work on the West Coast, with offices at 735 Battery St., San Francisco, Calif.

Northwest Plastics, Inc., St. Paul, Minn., has formed its first subsidiary, **Northwest Plastics of Carolina, Inc.** at Gastonia, N.C. The $225,000 plastic molding plant will service electric and electronic component industries with intermediate plastic parts used in the manufacture of their products. The parent company will maintain its St. Paul operation and continue its molding work and making of dies required at St. Paul and Gastonia.

Harold T. Sumner, who formerly operated his own hosiery mill in Gastonia, appointed manager of the subsidiary. **Donald A. Bullard**, molder and tool maker with the firm since 1941, will be transferred from St. Paul to supervise the technical work at the new plant.

Carlon Products Corp. has built a new $300,000 plant in Aurora which adjoins its laboratory and sewer pipe and conduit plant. It replaces a plant that burned down last April in Auburn, Ohio. The new plant will be devoted entirely to production of plastics pipe fittings. **Gordon Fernald**, formerly with Tube Turns, Inc., will manage the plant. **William Abramowitz**, president of Carlon, says that the new plant is only one of many steps that will be

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High-impact resistance over a wide temperature range proves Ethocel® an outstanding plastic among materials of all types. With end caps made of this Dow ethylcellulose, this luggage can travel to the tropics or the North Pole—get kicked, slid, and banged about—and still maintain its good looks. In addition, the body is made of vinyl sheet bonded to Dow magnesium. Result: luggage so light you can lift it with one finger . . . so strong you can stand on it.

Also, the manufacturer of the above freezer chose super-tough Ethocel for the extruded breaker strips and molded corners. Finding wide application in refrigerators as well, Ethocel offers extremely high-impact resistance at temperatures as low as −40°F., low moisture absorption, superior dimensional stability, and high surface gloss for easy cleaning. The lid liner of this freezer is vacuum formed sheet extruded from another high-impact Dow plastic—Styron® 475.

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PLASTICS DIVISION

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taken to enlarge Carlon's position in the plastics pipe industry, which he claims is the largest producer of plastics pipe in the business.

In the meantime, the Cleveland plant, where the company's plastic pipe originated, is being diverted entirely to the production of custom extrusion for such items as clear and opaque tubing, vacuum cleaner attachments, tubing and shapes for aircraft and automobiles, and rigid and flexible plastic sections. Carlon claims to be the only manufacturer extruding tubing in sizes up to 23 in. in diameter. **James D. Cleminshaw,** formerly handling pipe sales in the west, is general manager of the Custom Extrusion Div.

Chas. S. Fields, Inc., Lodi, N.J., is now expanding in several directions. A new Farrel-Birmingham "L" type calender with cross-axis rolls has been recently installed in a new addition to the original company building. Cross-axis rolls save down time normally expended when rolls have to be recrowned if production thickness of vinyl film or sheet is changed to any great extent. The new calender will be used for producing supported and unsupported sheeting, including the company's recently announced clear and semi-rigid vinyl sheeting. (See Plastiscope, p. 39, September 1957). The new addition has been wired for installation of a third calender line and a coating plant is expected to be installed later. Equipment now includes two calenders, three Banburys, and a press polisher, the latter used for making planished or patent vinyl used in women's handbags, wallets, and other such items. Fields has been a leading producer in the patent vinyl field for many years but is now expanding into those mentioned above.

A building for finishing operations is also about ready for installation of equipment where printing, embossing, and laminating will be performed. The site of the company's operations now includes 7½ acres, 50% of which is occupied by the five buildings now required for production of the firm's Miralon line of vinyl chloride products.

Chas. S. Fields is president of the company, **Irving I. Schnur** is secretary, and **Sidney Fields** treasurer. **Milton Radcliffe,** formerly of Textileather, and **Milton J. Chinich,** formerly of Harte & Co., are in charge of production and formulation. **Jack Liss,** formerly of Marbek Co., is manager of the new Miralon Plastic Fabrics finishing plant. **Leon Pober** will be in charge of the Automotive Sales Div. and **Frank Gryl** is director of engineering.

Deceased

O. W. Marsh

Orlo W. Marsh, 61, vice president of **The General Industries Co.,** Elyria, Ohio, died suddenly on August 22. Mr. Marsh, an early entrant in the plastics industry, was a member of The Society of the Plastics Industry, Inc. and Society of Plastics Engineers, Inc.

Meetings

Plastics groups

October 8: Society of Plastics Engineers, Inc., Regional Technical Conference, Curtis Hotel, Minneapolis, Minn. Subject: "Isocyanates."

October 10-11: The Society of the Plastics Industry, Inc., Thirteenth Annual New England Section Conference, The Wentworth-by-the-Sea, Portsmouth, N. H.

October 16: The Society of the Plastics Industry, Inc., Cellular Plastics Conference, Hotel Commodore, New York, N. Y. Subject: "Cellular Plastics in House and Home."

October 17: Society of Plastics Engineers, Inc., Regional Technical Conference, Hotel Carter, Cleveland, Ohio. Subject: "Polyethylene—Properties and Uses."

November 11: Society of Plastics Engineers, Inc., Regional Techni-

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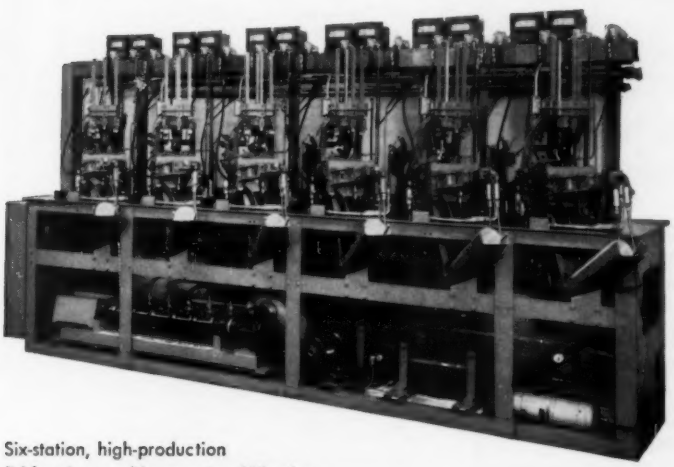
Mold temperature controlled "on the button" to keep plastic lid output high

Precise control of mold temperatures is a must on this Model EM-132 plastic lid-forming machine built by Emhart Mfg. Co., Hartford, Conn. The transparent plastic lids come shooting out of the machine at the rate of 90 per minute or more, so every machine function must be "on the button" to keep quality and quantity standards high.

Like so many other builders of quality machinery for the plastics industry, Emhart selected Wheelco Capacitrols to give fast and accurate control of mold temperatures and to insure trouble-free operation for long periods. Wherever you go throughout the plastics industry, whether the job calls for high-volume production of small parts like these or requires work on large, complex components, you'll find Wheelco instruments are always preferred. Learn the reasons why by writing today for Bulletin F-6485, "Capacitrols for the Plastics Industry."



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lid-forming machine uses two Wheelco
Capacitrols at each station for precise mold temperature control.

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cal Conference, Ambassador Hotel, Los Angeles, Calif. Subject: "Plastics for Air-Borne Electronics."

December 10-11: The Society of the Plastics Industry, Inc., Eighth S.P.I. Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York, N. Y.

January 28-31, 1958: Society of Plastics Engineers, Inc., Fourteenth Annual Technical Conference, Sheraton-Cadillac Hotel, Detroit, Mich. Subject: "Progress Through Plastics Engineering."

February 4-6: The Society of the Plastics Industry, Inc., Thirteenth Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

March 26-29: The Society of the Plastics Industry, Inc., Pacific Coast Section, Fifteenth Annual Conference, Palm Springs, Calif.

Other meetings

November 20-21: The Chemical Market Research Association, Joint Meeting with Chemical Commercial Development Association, Shamrock Hotel, Houston, Texas.

November 20-22: American Society for Testing Materials, Meeting of Committee D-20 on Plastics, Cavalier Hotel, Virginia Beach, Va.

December 2-6: Twenty-sixth Exposition of Chemical Industries, Coliseum, New York, N. Y.

December 4-5: Building Research Institute, Conference on "Adhesives and Sealants in Building," Shoreham Hotel, Washington, D. C.

January 5-10, 1958: Independent Home Furnishings Exhibit, Morrison Hotel, Chicago, Ill.

January 16-23: National Housewares Manufacturers Association, Twenty-eighth National Housewares Exhibit, Navy Pier and Drill Hall, Chicago, Ill.

February 6: The Chemical Market Research Association, Joint Meeting with Chemical Commercial Development Association, Sheraton-Park Hotel, Washington, D. C.

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Companies . . . People

B. F. Goodrich Chemical Co.: Robert P. Kenney appointed director of product and process licensing. Mr. Kenney recently returned to this country after a two year stint as European director of chemical activities for **The B. F. Goodrich Co.**, representing both BFG Chemical and The B. F. Goodrich Research Center. His new position will include all of the functions of his previous assignment, but will broaden them to include both domestic and international licensing activities. **Kenneth R. Parker,** manager of market research, recently elected to the office of president-elect of the **Chemical Market Research Association.** A past treasurer of the national organization, Mr. Parker will assume the presidency next year. **Richard D. Satava,** with the company since 1952, named plastic materials sales representative; he will make his headquarters in the Cleveland district sales office.

R. P. Kenney

K. R. Parker

Allied Chemical & Dye Corp.—Barrett Div.: Four appointments made in the Plastic and Resins Manufacturing Dept.: **James L. Hogeboom,** formerly superintendent of the coating resins plant, named superintendent of the molding compound plant at Toledo, Ohio. **Robert Q. Hunter** succeeds Mr. Hogeboom at the coating resins plant. **Willard W. White, Jr.** previously superintendent of the Greensboro, N. C., plant, appointed assistant superintendent of the coating resins plant. **George A. Johnston,** formerly superintendent of quality control for industrial resins at Toledo, now superintendent of the Greensboro plant. **Robert D. Weant** named sales representative for Plaskon industrial adhesives, covering the furniture industry in North Carolina and Virginia.

Foster Grant Co.: Dr. Robert L. Purvin, formerly president of Purvin & Gertz, Inc., consulting engineers in Dallas, elected executive vice president. In 1954, Dr. Purvin developed a plan using a combination of processes for making butadiene and aviation gasoline directly from butane hydrocarbons which resulted in the establishment of Texas Butadiene & Chemical Corp. He served as president pro tem of the corporation for the first year of its operation. **H. Muehlstein & Co., Inc.,** New York, N. Y., re-appointed national sales representative for the full line of Fostarene polystyrene.

The Goodyear Tire & Rubber Co.: M. E. Wendt appointed manager of chemical materials and products development. He will be responsible to **H. R. Thies,** general manager of the Chemical Div., on all matters pertaining to the development of high polymer resins, rubbers, and latices and to **J. S. Bruskin,** general manager of the Films and Flooring Div., on matters concerning vinyl flooring, packaging films, and plastic films and sheeting. Mr. Wendt joined Goodyear in 1938 and for two years performed research on coatings and adhesives. He helped organize the preliminary pilot plant for production of synthetic elastomers.

Chemical Div.: H. D. Allick, former New England special representative for plastic products, appointed sales development manager; **D. W. Klune** assigned to the sales service staff.

American Cyanamid Co.: Kenneth C. Towe, president since 1952, elected to the newly created post of chairman of the board; **Dr. Wilbur G. Malcolm,** formerly vice president-marketing, elected president and chief executive officer; **Kenneth H. Klipstein,** vice president, elected to the board of directors. **Philip B. Watson,** with the company since 1924, has retired as plant manager of the Wallingford plant of the Plastics and Resins Div., a post which he has held since 1941. He will continue with the company as a consultant in several areas, particularly in manufacturing, and the industrial and public relations fields. **Daniel McC. Collette** succeeds Mr. Watson as manager of the Wallingford operation. Mr. Collette joined Cyanamid in 1941. Formerly manager of the firm's Niagara Falls plant in Ontario, he has served as plant manager at Azusa, Calif., and as assistant general superintendent at Welland, Ont.

Union Carbide Corp.—Silicones Div.: R. S. Abrams appointed general manager and **L. J. Sinnott** general sales manager of the division. Mr. Abrams joined Union Carbide in 1941, starting at Linde Air Products Co., a Div. of Union Carbide; Mr. Sinnott joined Linde Air Products in 1942 as a development engineer.

Bakelite Co.: Robert F. Traflet named technical representative for the Molding Materials Div. in the Detroit district office. **Edward R. Kearney** transferred from the Vinyl-Polyethylene Div. at Bound Brook, N. J., to Bakelite's Ottawa, Ill., plant.

Eastman Chemical Products, Inc.: subsidiary of **Eastman Kodak Co.:** An "exchange-of-duties" training program has been formulated to meet the company's need for men with broader knowledge and experience in all phases of its Chemical Div.'s activities. It is expected that the program will require assignments of from 1 to 2 years to provide each participant with a background of experience in his new responsibilities. The first exchange in the new program will involve **J. H. Sanders** and **R. W. Miller.** Mr. Sanders is currently the Chemical Div.'s Cleveland district manager. Mr. Miller is presently product manager for all industrial chemicals manufactured by Kodak's Texas Eastman Div. in Longview, Texas. In taking over Mr. Miller's desk at the company's head office in Kingsport, Tenn., Mr. Sanders will assume responsibilities for marketing all Texas Eastman chemical products—market research and analysis, production planning, product development, coordination of sales and production, and long-range planning. Mr. Miller's move to Cleveland will place him in charge of the division's direct sales in that area. **Paul Rich,** now sales representative for the Plastics Div. at Leominster, Mass., will handle Tenite plastics in the New England area.

Monsanto Chemical Co.—Plastics Div.: W. T. Dickens, with the company since 1938, named assistant to the director of sales at Springfield, Mass. **Harry R. Nettleton** appointed to the Lustrex Dept., **David S. Frazer** to the Saflex Dept., and **Cornelius A. Cleary** to the Patent Dept. **Dr. Thomas R. Ames** has joined the Research Dept. **Dr. Lawrence J. Hughes,** formerly with the Organic Chemicals Div., named to the Research Dept. of the Plastics Div. at Texas City, Texas. **Joseph R. McCleskey,** formerly with the division at Long Beach, Calif., now with the Production Dept. at the Texas City plant.

Organic Chemicals Div.: Howard S. Bergen, Jr. former technical sales specialist on plasticizers, and **August R. Hempel,** former technical sales specialist on resin materials, have been appointed managers of plasticizers and resins, respectively, at St. Louis, Mo. Mr. Bergen comes from the division's Los Angeles sales office and succeeds **Howard I. Armstrong** who has been named Chicago district sales manager. Mr. Hempel was in the Cincinnati sales office and replaces **H. James Lawler** who

(*To page* 306)

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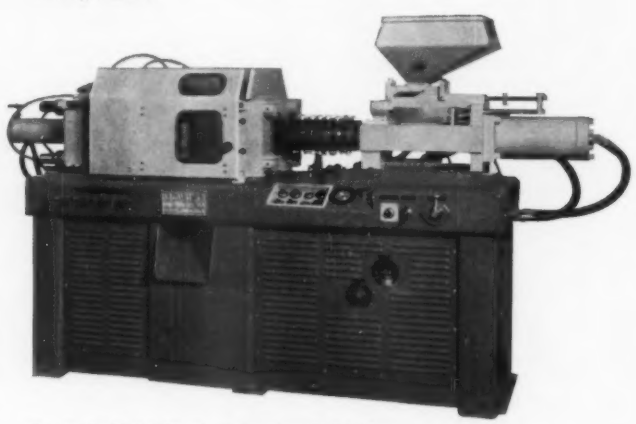
Hydraulic pull-back for plasticizing assembly is optional equipment on 2 ounce model and standard equipment on Model 75.

The Moslo Model 74—2 ounce automatic injection molding machine



The Moslo Model 75—4 ounce automatic injection molding machine

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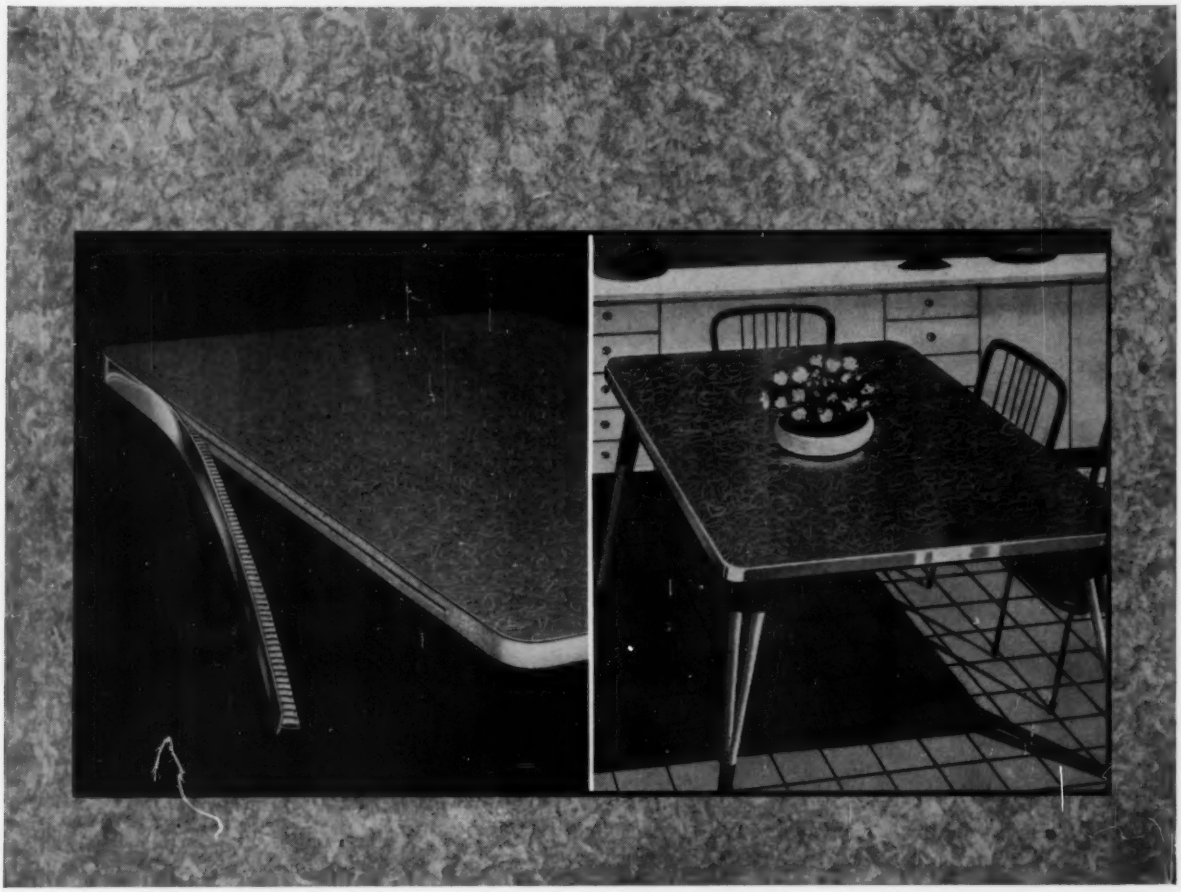
AN IDEAL BASE FOR BETTER PRODUCTS



WEYERHAEUSER 4-SQUARE PARTICLE BOARD—
contributes to long-term quality and wear

DECORATIVE PLASTICS for beauty and utility in the surface . . . 4-Square Particle Board for soundness and stability in the core . . . here's a combination that's sure to add up to sales.

As a core material, 4-Square Particle Board contributes to the quality of your finished products in many ways. Because of its smoothly sanded surfaces and uniform density, decorative plastics and wood veneer sheets can be mounted under pressure directly to panels without cross-banding. This completely eliminates a problem often encountered with some core stocks. Edges can be finished with metal mouldings or strips of surface material as shown at upper left.

For many reasons, 4-Square Particle Board is highly recommended as a corestock for dinette and kitchen table tops, sink and counter tops, for furniture parts, cabinet and sliding doors. The smooth, sanded panels provide a strong glue bond surface. The wide range of thicknesses and densities enables you to meet many special needs. Another important reason . . . there is no surface grain to raise, check or twist. Panels are 4′x8′. Smaller sizes can be furnished precut to individual requirements.

Weyerhaeuser Sales Company
DEPARTMENT PJ 107
First National Bank Building • St. Paul 1, Minnesota

Write for sample

Check the smooth surface and uniform texture that means better manufacturing results. Write today for sample and literature.

Companies . . . People

has been promoted to assistant director of sales at St. Louis with overall responsibility for plasticizers, resin materials, and paper chemicals sales.

Houghton Laboratories, Inc.: Donald Roon, formerly executive vice president, elected president to succeed **Russell M. Houghton** who has resigned. **Jean Cauchois, Jr.** named manager of the Adhesives and Coatings Div. **John M. Jewell,** with the firm since 1950, appointed to the newly created position of field sales manager. The company compounds epoxy resins and manufactures a line of products for the electrical insulating, adhesives, and plastics tooling fields.

The General Tire & Rubber Co.: Edwin A. Norris named general manager of the Marion Div. in Indiana which produces General's new Polyfoam urethane foam as well as reinforced fibrous glass products. **Robert Wilbur,** general sales manager, and **A. L. Herrick,** factory manager, will report to him. **William J. McCaig** appointed manager of Polyfoam sales.

Auburn Plastics, Inc., Auburn, N. Y., is the new name of the company formerly known as Auburn Button Works, Inc. The firm originally machined buttons from shell, then molded garment buttons out of shellac composition, and later from phenolic and ureas. Buttons, however, became a decreasing factor in Auburn's business and were discontinued in 1945. The company now produces component plastic parts for automobiles, business machines, and general industry.

Frank W. Egan & Co.: Following officers elected: **Frank W. Egan,** chairman of the board; **Edward F. Egan,** president; and **William H. Willert,** vice president in charge of the Plastics Machinery Div. **Lawrence W. Egan** continues as vice president and secretary and **Robert C. Sturken** as vice president and treasurer. **David A. Verner** named chief engineer. The company manufactures machinery for the plastics and paper converting industries.

The Dow Chemical Co.: Donald Williams, with the company since 1924 and vice president and director of sales, appointed to newly created position of director of corporate relations. He will have the responsibility of developing and directing a new Corporate Relations Dept. to be concerned with all the company's relationships with other firms, including those in the chemical and allied industries, Dow customers, and potential customers and suppliers. The new department will maintain close association with all Dow operations, including sales, purchasing, research, and production. **Donald K. Ballman,** formerly general sales manager of the company since 1949, promoted to director of sales to succeed Mr. Williams. **William R. Dixon,** former assistant general sales manager since 1951, promoted to general sales manager. Mr. Ballman has been active in both sales and sales development since he joined the company in 1935. His interest in product development led to the formation of the company's Technical Service and Development group in 1943 under his supervision. Last year he received the annual honor award of the Commercial Chemical Development Association for his pioneering efforts and leadership in product development work. Mr. Dixon has been with Dow since 1936, beginning in the Cellulose Products Div. He was assigned to the New York office in 1939 as the company's first branch office salesman in the plastics field. He returned to Midland headquarters in 1941 where he became assistant sales manager of the Plastics Dept. in 1943.

D. K. Ballman

W. R. Dixon

Eugene L. Martinez, with the firm since 1945, promoted to manager of the Boston sales office. **E. H. Killheffer, Jr.,** with Dow since 1943, succeeds Mr. Martinez as manager of the Buffalo sales office.

General Electric Co., Chemical Materials Dept.: West Coast sales headquarters for Glyptal alkyd resins and polyester resins consolidated with manufacturing facilities. The department has been moved from 1052 W. 6th St., Los Angeles, to 1211 N. Olive St., Anaheim, Calif., and will continue to serve western markets with Glyptal alkyd resins for the paint industry, and polyester resins for reinforced plastics from Anaheim. San Francisco sales office established at 436 Peninsular Ave., San Mateo, Calif., with **R. M. Kavish** in charge.

Silicone Products Dept., Jerome T. Coe, with the company 15 years and formerly sales manager, appointed manager of marketing at Waterford, N.Y. He succeeds **T. C. Ohart** who has become general manager of the Insulating Materials Section. **Reuben Gutoff,** with G-E since 1948 and previously manager of process engineering, now manager of resin and fluids operations in the Manufacturing Section.

Archer-Daniels-Midland Co.: Burton W. Schroeder, assistant manager of the Chemical Products Div., elected vice president of the company.

New branch office established at 18333 James Couzens Highway, Detroit, Mich. **Eugene L. Bulgozdy,** formerly technical sales representative at Cleveland, will manage the office. **Gerald C. Berry** transferred from the Cleveland sales staff to Detroit as a technical sales representative. They will handle sales of ADM resins, oils, plasticizers, and fatty acids in lower Michigan.

Resin and Plastics Div.: J. C. Burkholder to assistant to the manager of the division; **Fred Burnett** to manager of product and sales planning.

Oronite Chemical Co.: H. I. Allen promoted to head up the technical service group of the Marketing Dept. He succeeds **M. P. Youker** who was promoted to assistant manager, Western Export. **Thomas J. Shea** made New York sales representative.

Society of Plastics Engineers, Inc.: Following officers elected for the Western New England Chapter for a 1-yr. term: **Raymond Mazur,** president; **Richard Plichta,** vice president; **Wesley Larson,** secretary; and **Edward Duda,** treasurer. **Blakely McNeill** appointed program chairman and **Lawrence Freeman** membership chairman.

Narmco, Inc.: Finn Claudi-Magnussen named materials and process engineer. His appointment follows recent ground-breaking for a $1 million Research Center for structural adhesives, reinforced plastics, and sandwich structures.

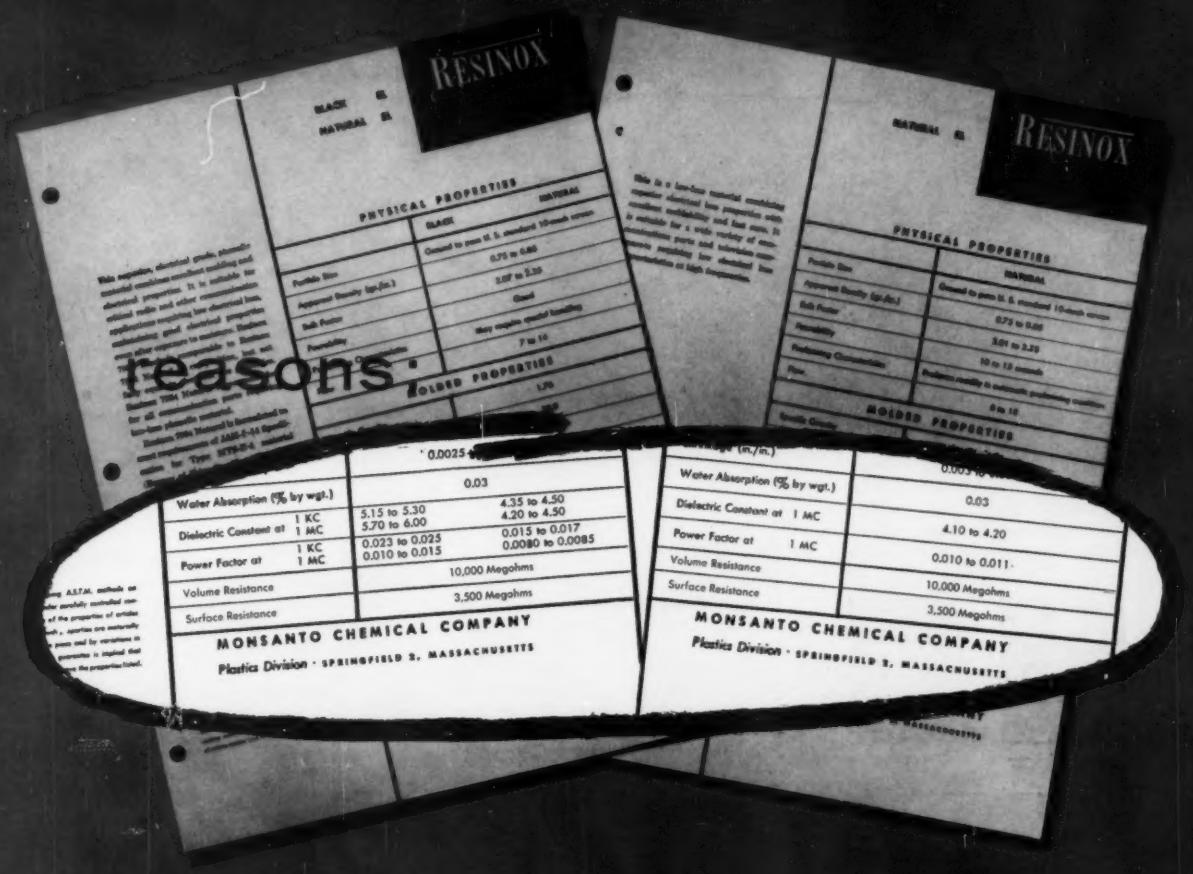
Narmco Resins & Coatings Co.: Thomas Holdridge, formerly with Hughes Aircraft, appointed head of the newly created Technical Sales-Service Dept., Costa Mesa, Calif. The firm produces structural adhesives, laminating materials, and related products for aircraft and commercial industries.

National Polychemicals, Inc.: Joseph P. Flannery, formerly administrative assistant, appointed sales manager. His former affiliations were with The Kendall Co. and Monsanto Chemical Co. **Robert F. Gosselin** succeeds Mr. Flannery as administrative assistant. **Jean H. Nesbit** named midwestern district manager, with headquarters in

FOR LOW-LOSS HIGH FREQUENCY APPLICATIONS

RESINOX 7934 AND 10900

SET THE STANDARD



In the vital properties that determine good performance in low-loss high frequency applications (such as water absorption, power factor) data sheets on 7934 and 10900 speak for themselves.

Formulated to meet MIL-M-14E specifications for type MFE (electrical low loss phenolic), Monsanto's mica filled phenolic compounds continue to set the standard for end use performance in such applications as radio tube sockets, connectors, and capacitors.

New improvements in molding characteristics clear the way for still wider use for these molding compounds.

Now is the time to re-examine Resinox 7934 and 10900 for your communication parts and television components. Write for samples and complete technical data to Monsanto Chemical Company, Plastics Division, Room 1767, Springfield 2, Massachusetts.

*RESINOX: REG. U.S. PAT. OFF

Monsanto

Companies . . . People

Buffalo, N. Y., and **Hugh W. Gillon, Jr.** midwestern sales representative. The company is currently building a new plant to produce special organic chemicals at its 60-acre site north of Boston.

Landers Corp.: Timothy Y. Hewlett, Jr. elected secretary and treasurer and **Earle A. Wentworth** assistant treasurer. Mr. Hewlett will also continue as purchasing agent. **Robert L. Nowicki, Richard A. Potter,** and **Julian H. Stevens** appointed territorial sales managers. Mr. Nowicki will be in charge of sales for the Chicago marketing area; Mr. Potter will cover the central territory in Todelo; and Mr. Stevens will handle the Cleveland area. The company manufactures vinyl-coated and processed fabrics.

Brown-Allen Chemicals, Inc.: Joseph J. Hitov named assistant to the president. **Peter Abruzzo** appointed plant manager. The company makes plasticizers and other chemicals.

Diamond Alkali Co.: A. L. Geisinger, vice president and general manager of the Plastics Div. and a 38-year veteran with the firm, will retire at the end of the year. He held this post since the division was organized in 1953. **James P. Okie,** assistant general manager, succeeds Mr. Geisinger as general manager. His appointment is effective immediately. Until his retirement, Mr. Geisinger will continue as a vice president of the company. **Dr. Clifford A. Neros** appointed group leader in the Product Development Section of the Central Research Dept. With headquarters at the Diamond Research Center, he will continue to direct laboratory work relating to product evaluation and applications research on new chemicals and plastics. **James L. Foster** is now group leader in silicate research for the firm's Silicate, Detergent, Calcium Div.

A. Geisinger

J. Okie

Farrel-Birmingham Co., Inc.: Edwin H. Ahlefeld, Jr. appointed sales manager in charge of sales and engineering of processing machines for the plastics and rubber industries. He joined the company in 1945 as a senior sales engineer, was named manager of Banbury mixer sales in 1950, and became assistant general sales manager in 1955.

Watson-Stillman Press Div.: T. R. Callahan, formerly Buffalo-Rochester representative, now mid-western sales representative, with headquarters at 10725 S. Western Ave., Chicago, Ill.

Aries Associates, Inc. has moved from 41 E. 42nd St., New York, N. Y., to new and enlarged quarters at 77 South St., Stamford, Conn. This is the first step of a move to consolidate the activities of the Aries organization which until now had drafting facilities in Brooklyn and laboratories in Long Island City, N. Y. All these are expected to be consolidated in the near future in an "ARIES" building in Stamford.

Parsons & Whittemore Graphic Corp., New York, N. Y., appointed exclusive U. S. distributor for the Kleina-Rotoplast combination multicolor flexographic press and bagmaker made by **Bielloni Co.,** Milan, Italy. The "Kleina" press prints paper, cellophane, polyethylene, and other flexible materials in 2, 3, or 4 colors at speeds up to 325 ft./min.

The Kendall Co.—Polyken Sales Div.: Three new distributors appointed: **Donold Corp.,** 308 E. Sixth Ave., Des Moines, Iowa, and **Shutt Process Equipment Corp.,** 5627 Manchester Ave., St. Louis, Mo., will cover the midwest area; **Simcoe Equipment Co.,** Plymouth Bldg., Minneapolis, Minn., will service the northern-midwest area. These distributors carry the complete line of Polyken polyethylene protective tape coatings, including 12-mil products for straight run pipes and accessory use, ells, accessory valves, and fittings. A 20-mil product is furnished for applications where extra thickness and toughness are desirable or where double-coating would be specified with older type coatings.

Scientific Design Co.: Thomas P. Brown and **Walter N. Alexander** appointed to newly created positions of senior vice presidents. The following assistant vice presidents promoted to vice presidents are: **Henry F. Peters,** engineering; **David Brown,** research and development; and **Philip E. Newman,** European affairs.

Automatic Molding Machine Co.: Barnett J. Danson & Associates, Ltd., 1912 Avenue Road, Toronto, Ont., named representative to handle sales of Automold fully automatic 25- and 50-ton compression molding machines in the Dominion of Canada. **Automation Equipment & Supply Co.,** 520 Empire Bldg., Pittsburgh, Pa., appointed representative to handle Automold sales in West Virginia.

Mobay Chemical Co.: S. A. D. Visser, of Holland, has joined the Research Dept. as a member of the Intermediates Group; **Charles D. Nolen** now with the Isocyanates Polyesters Group.

George Woloch Co., Inc. has moved the main office from 601 W. 26th St. to its new building at 514 W. 24th St., New York, N. Y. The firm will continue to maintain its New York warehouse at the 26th St. location.

American Molding Co., plastics custom molder, has opened an engineering and sales office at 6057 Wilson Ave., Hollydale, Calif. The company recently moved into its new 45,000-sq. ft. plant at 2002 Davis St., San Leandro, Calif.

D. B. Becker Co., Inc., 150 Nassau St., New York, N. Y., retained by **Tamms Industries Co.,** Chicago, Ill., to take over the marketing of its raw materials. Industries to be served include plastics, rubber, paint, buffing, etc.

Shelly, Inc., Farmington, Minn., is the new name of the company formerly known as Herb-Shelly, Inc. The company, engaged in polyethylene packaging, is a division of **Brown & Bigelow.**

Yardley Plastics Co.: Richard D. Ford named direct factory representative in Dallas, Texas; **Robert Green** appointed direct factory representative in Plainview, Texas.

Haveg Industries, Inc.: J. A. Coffman returns to the company as district manager, with offices at 12827 E. Imperial Highway, Norwalk, Conn. **Tom McGrath,** formerly an engineer at the firm's resin plant, now district engineer at the Cleveland office.

Eastman Atlantic Mfg. Co., Atlanta, Ga., named warehousing distributor for Alabama, Georgia, and Florida by **Resistoflex Corp.,** manufacturer of precision hose and hose assemblies.

James Cunningham named sales manager of newly-formed **Witco Chemical Co., Canada, Ltd.,** Toronto, Ont. He was formerly a sales representative in the New York area for the parent firm, **Witco Chemical Co.**

Synthane Corp.: Detroit sales office relocated from 811 Stephenson Bldg. to 920 E. Lincoln, Birmingham (a suburb of Detroit), Mich. **William H. Borden** is district manager, as-

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of virgin
VINYL
MOLDING COMPOUNDS...

call the
GIANT
with the delicate touch

Quality controlled to meet customers' exact specifications . . . that's the Gering difference in custom color-compounded vinyl materials . . . regardless of their specific end use! And with Gering's large-scale yet efficient operation, you can be sure of fast delivery on competitively priced virgin vinyl formulated and compounded to your exact injection or extrusion needs. More than 30 years of prompt response to customers' individual needs has earned Gering an unrivaled reputation as "color compounding specialists."

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- **General Purpose** virgin vinyl formulations ideal for the majority of non-specialized applications.
- **Non-toxic Formulation** for beverage tubing, food processing, medical/surgical tubing, toys and other critical applications.
- **Petroleum Resistant Formulation** for applications where contact with oils, greases and solvents is required.
- **Low Temperature Resistant Formulation** where retention of flexibility and strength at temperatures to minus 20° F. is required.
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- **High Temperature Resistant Formulation** to retain form and shape at higher than normal temperature uses up to 220° F.
- **Non-migrating and Non-staining Formulation** for use with nearly all other materials susceptible to plasticizer migration.
- **Ultra-high Gloss Formulation** for applications where extremely bright finish and rich surface appearance are of prime importance.

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Virgin Thermoplastics: Vinyl • Polyethylene • Acetate • Polystyrene • Impact Styrene

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Companies . . . People

sisted by John Decker. **Charles B. Morgan,** formerly superintendent of molding and assistant manager of production, named general manager of production. He succeeds **Duane E. Roland** who has retired after 28 years with the company.

L.O.F. Glass Fibers Co.—Corrulux Div.: Three new districts sales managers appointed: **William G. Catchcart, Jr.** for Chicago, Ill.; **Fred A. Laake, Jr.** for Dayton, Ohio; and **Henry Blount Selby** for Charlotte, N. C.

Corrosion Resistants, Inc. has moved to new and enlarged quarters at 53 Great Arrow Ave., Buffalo, N. Y. The company is a supplier of unplasticized PVC Type I and II sheet, bar, pipe and pipe fittings, valves, blowers, etc.

Saltpoint Supply Corp., 539 Hiawatha Blvd., Syracuse, N. Y., appointed distributor of Lamin-Art, a high-pressure decorative plastic laminate produced by **Fabricon Products, Div. of The Eagle-Picher Co.**

Orangeburg Mfg. Co., Inc. Carl F. Arnold, Joseph E. Milardo, and **Richard Ohlson** named sales managers for the Central Middle Atlantic, North Central, and Pacific Northwest districts, respectively. The firm manufactures plastic pipe.

Fiberfil, Inc.: John F. Volin, formerly with St. Regis Paper Co.'s Panelyte Div., named midwestern representative. **John M. Avery** now eastern representative. The company produces glass-reinforced injection molding compounds.

The Plumb Chemical Corp.: Joseph W. Mackenzie elected secretary and **George R. Beck** assistant treasurer. The firm produces fibrous glass-reinforced plastic molding compounds, tradenamed Fibercore.

Reiss Associates, Inc., Plastics Div.: Richard I. Miranda, with the firm since its inception in 1946 and comptroller since 1948, appointed treasurer of the company. **Burton A. Bromfield** named to newly created post of vice president in charge of engineering and methods.

A. L. McMullen elected vice president in charge of production, and a director of **Seiberling Rubber Co. of Canada, Ltd.,** a subsidiary of **Seiberling Rubber Co.,** Akron, Ohio. Mr. McMullen, with the parent company 18 years, replaces **James W. Ansley** who has resigned. Prior to his election to the Canadian post, he was manager of production in the Seiberling plants at Akron and Carey, Ohio.

Dr. Ross D. Spangler, with the company since 1944 and a research physicist for Du Pont's Polychemicals Dept., promoted to senior research physicist. Dr. Spangler will continue his studies at Du Pont's Experimental Station near Wilmington, Del., on physical and mechanical properties of plastics.

Russell M. Houghton, who recently resigned as president of Houghton Laboratories, has formed his own company to be known as **Conap Co.,** 619 S. Union St., Olean, N. Y. The firm will be engaged in research and development work devoted to the formation and application of synthetic materials. Mr. Houghton will also act as a consultant in this field.

Armand G. Winfield, formerly of Hanley Plastics Co., has joined **DeBell & Richardson, Inc.,** Hazardville, Conn. Mr. Winfield, who developed an epoxy based decorative panel while with Hanley, will continue his work on these panels while with DeBell & Richardson, and states that information concerning them should be addressed to him at his new location.

Dr. Roger Gordon Bates appointed chief of the Physical Chemistry Section of the **National Bureau of Standards,** succeeding **Dr. Edgar R. Smith** who has retired after 31 years service.

Stanley Bindman, vice president of **Jamison Plastics Corp.,** N. Bellmore, N. Y., has been awarded a citation from the **Society of Plastic Engineers, Inc.** "for his many years of diligent and devoted service to the New York Section of the National Society."

James R. Davidson appointed vice president and general sales manager of **Capac Industries, Inc.,** Capac, Mich., in connection with the firm's further diversification into the fields of extruding, forming, molding, fabricating, and finishing of thermosetting and thermoplastics products. Mr. Davidson was formerly executive secretary of the Society of Plastics Engineers, Inc.

Jan S. Irvine, named general manager of **Glass Plastics, Corp.,** Linden, N. J., will be primarily concerned with expanding the use of fibrous glass and other reinforcements. He was formerly manager of the Marine Div. of Owens-Corning Fiberglas Corp. Glass Plastics is a compounder of resin materials and glass fabrics for use in the covering and molding of boats.

Schnur-Appel, 2165 Morris Ave., Union, N. J., design consultants, now have facilities for experimental vacuum forming which include design and building of sample molds and test vacuum forming for the packaging and plastics industries. **David Wachter** named director of product development.

Joe M. Gafford named head of the Manufacturing Dept. of **W. R. Grace & Co.'s** high-density polyethylene plant to be operated shortly by the Polymer Chemicals Div. at Baton Rouge, La. He previously was superintendent of the Pensacola, Fla., plant of Escambia Chemical Corp.

Robert C. Medl now manager of technical development of **The Richardson Co.,** Melrose Park, Ill.

Karl N. Carter named vice president of **The H. O. Canfield Co.,** Bridgeport, Conn. He will be in charge of sales for the firm and its subsidiaries: **Virginia Rubber Corp.,** Clifton Forge, Va., and **Wabash Rubber & Plastics Corp.,** Seymour, Ind. The firms manufacture plastics, silicones, and rubber products.

E. J. Boebinger, formerly assistant to the vice president of the Manufacturing Div. of The Richardson Co., named plant manager of the Akron plant of **American Hard Rubber Co.** He succeeds **Kenneth J. Durant** who has retired.

Ric Leichtung appointed sales manager of the **Brookpart Dinnerware Div. of International Molded Plastics,** Cleveland, Ohio. The company manufactures melamine dinnerware as well as Structoglas reinforced plastics panels.

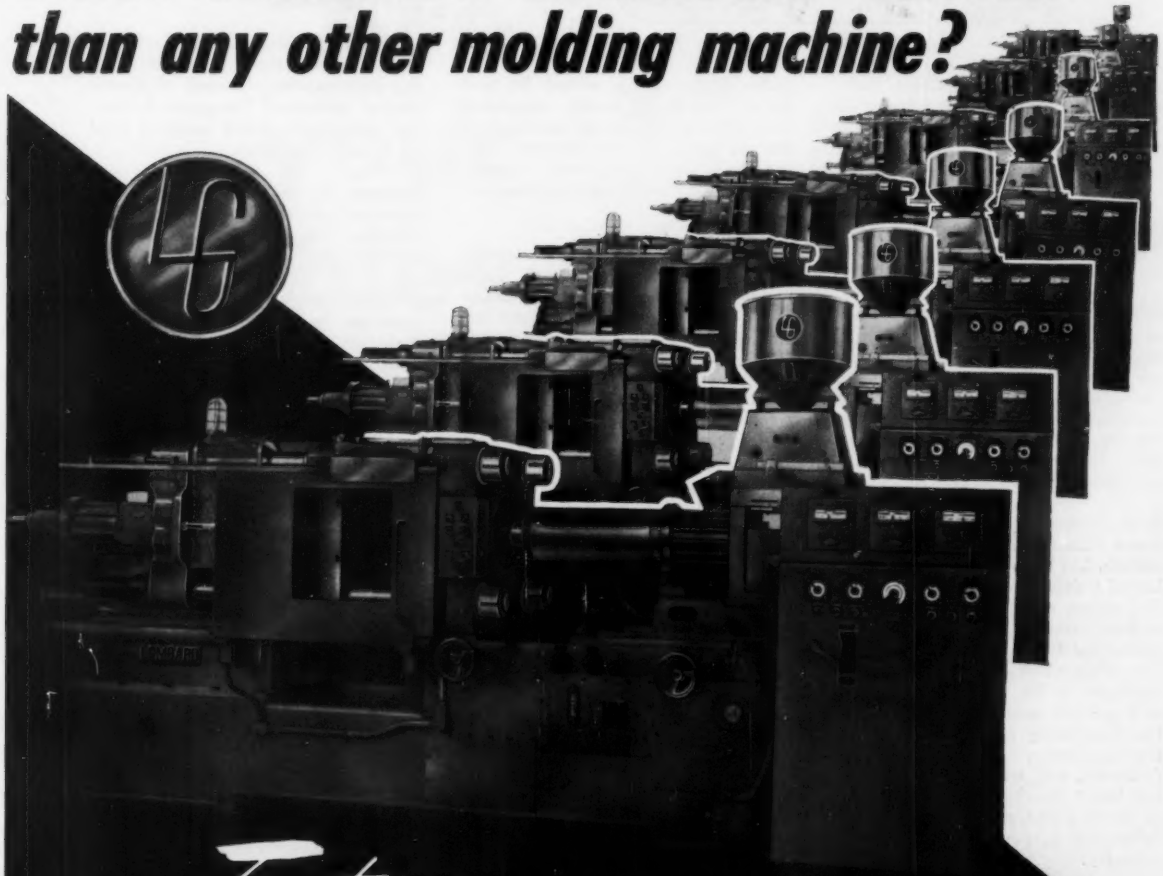
Harold G. Shelton appointed director of marketing of the **Dyestuff & Chemical Div. of General Aniline & Film Corp.**

Joseph E. Phalon appointed sales manager of the Proprietory Div. of **Flambeau Plastics Corp.,** Baraboo, Wis. The division includes housewares, premiums, and advertising specialties.

Robert A. Mitchell now chief engineer of **Blaw-Knox Co.'s** Midwest headquarters at Chicago, Ill.

W. Harrison Faulkner, Jr. promoted to general manager of engineering and development of **Tracerlab, Inc.** Mr. Faulkner, formerly chief engineer of the Industrial Div., has been with the company since 1948

What makes the LOMBARD BETTER *than any other molding machine?*



THESE *Features* OF COURSE!

1. MOLD OPENING STROKE
Lombard is the first machine with a 20" platen stroke. This is most desirable for molding products requiring a deep draw such as waste baskets and containers of similar shape.

2. HYDRAULIC VALVE PANEL
Exceptionally compact construction with complete accessibility to hydraulic valves mounted on this panel. Hydraulic piping is reduced to a minimum. Maintenance work can be performed more easily on the Lombard than any other machine.

3. WEIGH FEED is standard equipment. Essential for starve feeding in which quantity of molding powder per charge or "shot" must be the same for every molding cycle and for uniform production.

Rated casting area is increased up to 300 square inches and production is faster:

Mold closes in two seconds, opens in 1¾ seconds.

4. SAFETY DROP BAR
A safe guard with a positive stop prevents mold from closing while safety door is open. In the remote event of failure of any other safety device, the mold cannot close while operator is removing molded product or inspecting mold cavities.

5. LUBRICATION
All bearings in the toggle mechanism are lubricated from a central point. Oil is metered to each bearing in exact quantities. In the case of automatic lubrication, an adjustment provides for forcing oil into bearings at any interval desired for maximum economy and efficiency.

6. FLOOR SPACE
The Lombard occupies less valuable floor space than other machines of similar capacity.

7. PLASTICIZING CYLINDER
Lombard is the only machine available to date with an internally heated plasticizing cylinder having a capacity of 150 pounds per hour.

8. DESIGN
The Lombard was evolved by men with many years of experience in the design, manufacture, sales and servicing of injection molding machines. Being thoroughly informed in all phases, it follows that they have incorporated in the Lombard the maximum number of features desired by molders. The importance of this can be better evaluated by considering that many molders do not have a maintenance crew but require much work to be done by the foreman or set-up man or even an untrained machine operator.

9. THE FIRST LOMBARD
This machine was delivered in February of 1955 and has operated dependably for 24 hours a day, six days a week since. The same purchaser has ordered five additional machines at intervals of four to six months. There is no better recommendation than repeat orders.

LOMBARD GOVERNOR CORPORATION
ASHLAND, MASSACHUSETTS
New York Representative THE RAINVILLE CO. 224 7th Street, Garden City, N.Y.

Companies . . . People

and has served as business manager of its Western Div. Tracerlab manufactures a line of beta gages and other nucleonics control equipment used in the plastics and other industries.

Dr. A. L. Wooten, named technical director of the New England Div. of **Reichhold Chemicals, Inc.**

John M. Linforth elected chairman of the board of **Hexcel Products, Inc;** he will also serve on the Hexcel Management Committee. Mr. Linforth, 60, held the post of vice president of Goodyear Tire & Rubber Co., Inc. until his retirement in 1956. Hexcel produces honeycomb core materials.

B. D. Garware, president of **The All India Plastics Manufacturers' Association,** has been selected as a member of a delegation sponsored by the Federation of the Indian Chambers of Commerce and Industry and supported by the Government of India. The delegation will visit various countries in the world. Mr. Garware will contact representatives of plastics machinery and mold manufacturers, plastics raw material manufacturers, etc., with a view to study the latest developments in the field of plastics and explore foreign collaboration in developing the Indian industry.

Bruce S. Galbraith appointed eastern district sales manager of the Polyco-Monomer Dept. of **Borden Co.'s Chemical Div.** He was previously southwest regional sales manager of the Nuodex Products Div. of Heyden-Newport Co.

Carl K. Wolff appointed western regional sales manager of **W. S. Shamban & Co.,** manufacturer of Teflon and Kel-F products. He was formerly senior sales engineer and division product coordinator of National Seal Div., Federal-Mogul-Bower Bearings, Inc.

Robert Kirk has joined **Amoco Chemicals Corp.,** 910 S. Michigan Ave., Chicago, Ill., as manager for the international sales of the company's products, including petroleum additives, solvents, hydrocarbon resins, plasticizers, and chemical intermediates. For six years he was manager of Pittsburgh Coke & Chemical Co.'s Foreign Div. and president of Pittsburgh Chemicals Mexicana S.A.

Lawrence M. Baxt has joined the Colloidal Dispersions Dept. of **Columbian Carbon Co.** as chief chemist. He will be at the firm's Tacony plant, Philadelphia, where he will be in charge of newly completed laboratories. The firm produces a line of dispersions of carbon black in both aqueous and organic vehicles for plastics, paints, lacquers, enamels, etc.

Joseph S. McCulloch named northeast district manager for **Tube Turns Plastics, Inc.,** Louisville, Ky., with headquarters in Riderwood, Md. The company produces injection molded polyvinyl chloride fittings, flanges, and valves for industrial piping systems.

Peter W. Duff appointed assistant to **Raymond F. Clark,** executive vice president of **Hess, Goldsmith & Co.,** weaver of glass fabrics. Mr. Duff, who comes from Burlington Industries, will be concerned primarily with the company's Industrial Fabrics Div.

C. J. O'Sullivan, named technical representative for the New York district office of **Shell Chemical Corp.'s Chemical Sales Div.,** will be concerned primarily with sales of the company's Epon resins in metropolitan New York and Long Island.

Dr. James M. Church, professor of chemical engineering at Columbia University, elected a director of **Riverside Plastics Corp.** The firm is a custom fabricator and vacuum former in the aircraft, electrical, and industrial fields.

Howard E. Andersen, Jr. promoted to district manager of **Minnesota Rubber & Gasket Co.'s** Cleveland office. One of the divisions whose products he will handle is **Minnesota Latex Rubber Co.** which produces commercial and industrial plastic and rubber parts by the KotoKast process.

Victor E. Serrell, formerly field engineer of Bakelite Co. for 12 years, now with **Beach Plastics, Inc.,** Rochester, N. Y., manufacturers' representative.

David Brandmark named technical representative of **Claremont Pigments Dispersion Corp.,** Roslyn Heights, N. Y., to service gravure and flexographic printers of paper, film, and foil in New York and New Jersey.

Howard Gamble named to New England field sales staff of **F. J. Stokes Corp.'s Press Div.** and will work out of the firm's Portland, Conn., district office. He was formerly assistant to the manager of engineering of Bachman Bros., where he worked on the development of a line of injection molded plastic products.

Peter Muller-Munk, Pittsburgh designer, named the first president of the **International Council of Societies of Industrial Designers** following an organizational meeting held in London, England.

Stephen B. Sponder named plant manager of **Baker Brothers, Inc.,** Toledo, Ohio, builders of machine tools and plastic molding presses.

William Rudko appointed plant manager in charge of production facilities of **Rubber & Asbestos Corp.,** Bloomfield, N. J., manufacturer of industrial adhesives.

Donald H. Kocher, formerly with Monsanto Chemical Co., appointed manager of **Shawinigan Resins Corp.'s** Chicago office, succeeding **W. M. Young** who has been named resident representative in the Pennsylvania territory.

J. G. Carden named New York salesman for **Owens-Corning Fiberglas Corp.** He will handle textile products, including Fiberglas yarns for plastics, electrical insulation, paper, insect screening, and other uses.

Gerald E. Dodson has joined **American Aerophysics Corp.,** El Segundo, Calif., as a consultant in the organization and operation of the new fibrous glass-reinforced plastics laminate division.

John E. Slatky, formerly manager of technical sales for the firm's transparent plastic products, elected vice president of **Sierracin Corp.,** Burbank, Calif.

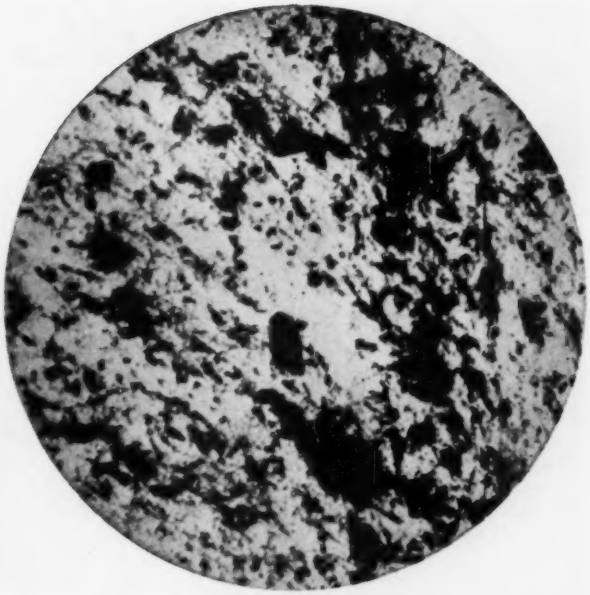
A. A. "Andy" Hume, 4938 Second Ave., S., Minneapolis, Minn., named factory representative for **Devcon Corp.,** Danvers, Mass. Devcon manufactures a putty-like plastic-metal compound which cures at room temperature to the hardness of steel.

Tom Steinbach, previously with Raymond Loewy Associates, appointed planning director of **Reinecke & Associates.**

Newark Paraffine Paper Co. and its affiliates, **Protective Packaging Corp.** and **Newark Foils, Inc.,** have moved from 50 Jelliff Ave. to 70 Blanchard St., Newark 5, N. J.

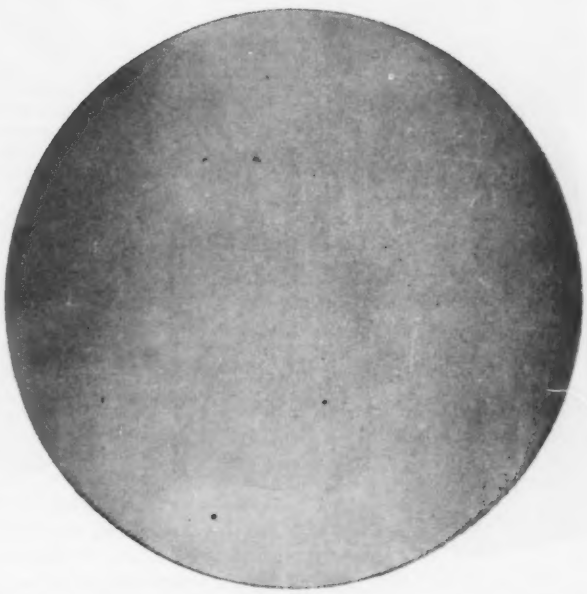
William J. F. Duggan, Jr. consultant for the company since the first of the year, elected a vice president of **Commercial Decal, Inc.,** Mt. Vernon, N. Y. His major responsibilities will be the development of new markets, diversification, organization, and internal controls.

Are your troubles caused by poor dispersions?



ORDINARY DISPERSION
MAGNIFICATION 140X

If you are making your own dispersions you may be discovering some problems . . . agglomeration, costly clean-up time, excessive compounding time and contamination. ADP Dispersions will eliminate agglomeration and contamination, reduce compounding time and clean-up time in your plant. Dispersion is a highly technical science, requiring specialized research and production techniques. ADP is unique in this respect, because of its background of close to a half-century of experience. ADP specialists, without obligation, will gladly consult with you. **Their business** is dispersions, and they know it thoroughly. They will be glad to help you.



ADP DISPERSION
MAGNIFICATION 140X

ACHESON DISPERSED PIGMENTS CO.

MORRIS BUILDING, PHILADELPHIA 2, PA.

West Coast Distributor: B. E. Dougherty Co., Los Angeles 21, Calif.

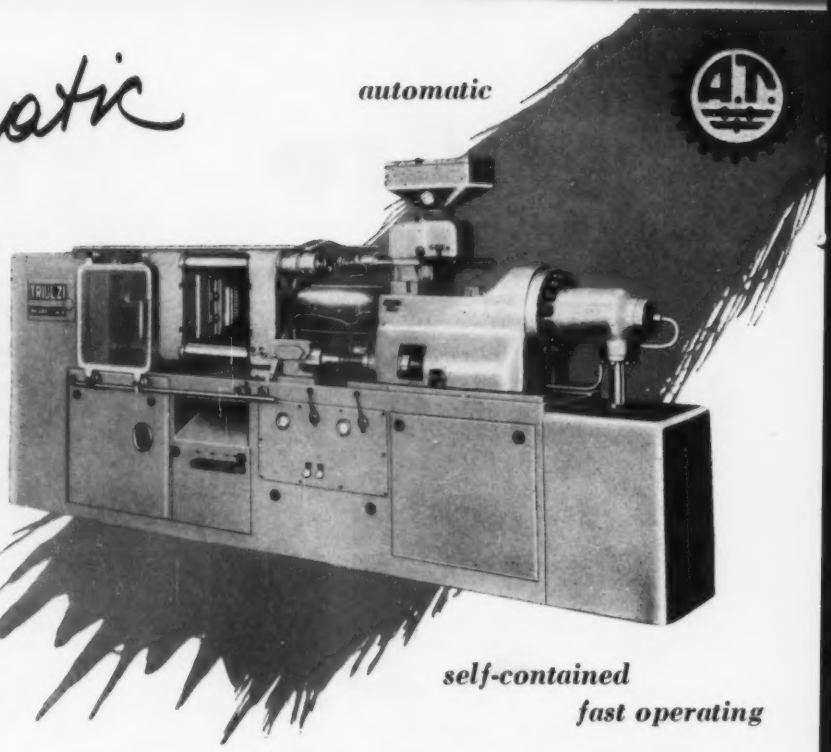
In Europe: Acheson Colloids Limited, 18 Pall Mall, London S.W.1, England

A UNIT OF ACHESON INDUSTRIES, INC.

Plastmatic

automatic

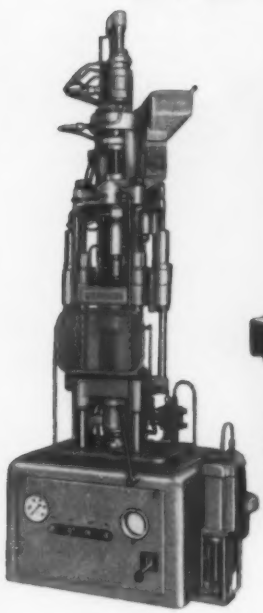
from 1 to
20 ounces

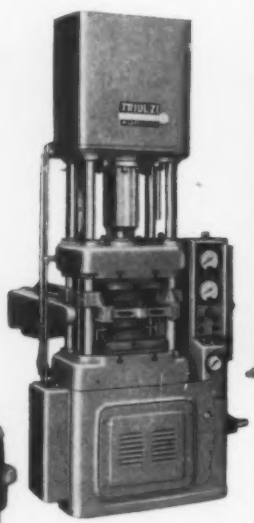


Model 200 GRS
7 oz. capacity

self-contained
fast operating

OTHER INJECTION MOLDING MACHINES
with ¼ oz. to 350 oz. capacities





Vertical injection molding press

Self-contained compression molding press with automatic dosing device

Multiple platen press for rubber and plastics laminates

Special press for polyester resins

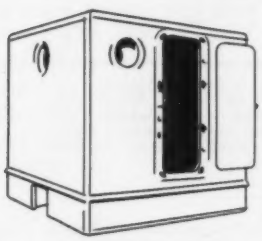
VERTICAL PRESSES FOR EVERY PLASTICS JOB

A. TRIULZI S.A.S.

MILAN, ITALY • VIA G. DE PROCIDA. 8

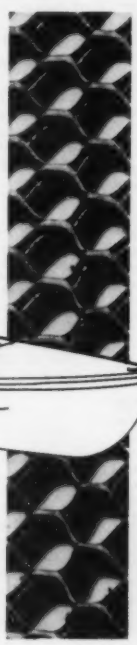
The remarkable "Monsanto House of the Future," built after more than three years of intensive research, incorporates the most modern structural concepts and materials. It is on display in Disneyland Park in California.
For tomorrow's problems . . .

AIRCOMB TRADE MARK *may be your solution, too!*



AIRCOMB SEA CABIN

AIRCOMB-HULLED BOAT



DOUGLAS AIRCOMB PRODUCTS TRADE MARK

The high standards set for the "Monsanto House of the Future" made the selection of the finest materials imperative. Douglas AIRCOMB—a phenolic Kraft honeycomb structure—was chosen as a primary structural element. Its great strength, rigidity and outstanding insulation properties made it ideal for use in ceilings, floors, interior partitions and sliding doors.

It will be worth the while of every plastics engineer and manufacturer to get the facts on this exceptional material. Small boat designers have been particularly interested in AIRCOMB's high strength to weight relationship and resistance to corrosion and have been using it extensively for hulls, decks and cabins.

Faced with glass laminates or plastics, AIRCOMB is potentially useful wherever the combination of high strength and light weight is desirable. It is guaranteed by Douglas to have uniform strength and rigidity.

Write for AIRCOMB brochure to:

AIRCOMB SECTION
DOUGLAS AIRCRAFT COMPANY, INC.
3000 Ocean Park Blvd.
Santa Monica, California

Classified Advertisements

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and equipment for sale

FOR SALE: 2500 ton downstroke 54" x 102". 800 ton laminating press with 23 openings 26"x38". 600 ton Baldwin downstroke 32"x36". 300 ton Multi opening 40"x40" platens. 300 ton upstroke press 22"x35". Elmes 200 ton 28"x26". Farrel 200 ton 30"x30". 200 Ton Hobbing Press 18" x14". Farrel 200 ton 20"x80". D & B 140 ton, 36"x36". French Oil 120 self-contained 18"x22". Adamson 80 ton 20"x20". Also Lab. to 2500 tons from 12"x12" to 48" x48". Hydr. Pumps and Accumulators. Stokes Automatic Molding Presses. Van Dorn 1 oz. Injection Molding Machine. Mills and Calenders to 84". Seco 6"x13" and 8"x16" Mixing Mills and Calenders. Plastic and Rubber Extruders. Oxford 57" Slitter. Rotary and single punch Preform Machines, ½" to 4". Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & Day Jacketed Mixers. Plastic Grinders. Gas Boilers. Partial Listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn, New York.

FOR SALE: 1 Royle 2" electric Spirod extruder; 1 Elmes 200 ton self-contained molding press; 5 Cumberland, Ball & Jewell granulators, 3 to 15 HP; 1 R. D. Wood 30 ton self-contained molding press; 1 Stokes T preform press; also mixers, choppers, mills, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N.Y.

SACRIFICE: Hydraulic 50 ton Southwark compression heavy duty press, automatic hydraulic pull backs. Like new complete over-haul, Rods, Bushings. 22 x 27 Electrical Platens, 50 gallon Universal tank pump units. Used only 40 hours on research. Theon Co., Inc., 417 Lafayette St., N.Y. 3, N.Y., AL 4-7228.

FOR SALE: Plastics Injection Molding Machines: HPM 4 oz., 9 oz., 16 oz., 42 oz., 60 oz. Impco 22 oz. Reply box 2728, Modern Plastics.

FOR SALE: Vacuum Metallizer 36",—Injection Presses: Jackson & Church 64 oz.—HPM 60, 48, 20, 16, 9 & 4 oz.—Lester 8 oz.— Watson 28, 12, 6 oz. Moslo 2½ oz. —Van Dorn 1 oz. Extruders: Stokes-Windsor Twinscrew RC 100. NRM oil-heated. 3½". Sheet Dies 24", 30". Pull-offs: 30", 52". Stacker 48". Dulmage Meter Pump 28". Despatch 48"x72" Sheet Preheat Oven. Scrapgrinders Cumberland 0,½. Leominster 5 HP. Apex 2 color Container Imprint Mach. Compression Presses 50 to 600 T. Elmes 30 T Hydrolair press. Preform presses: Kux 60, Colton 5½ T.—Baker-Perkins 200 gall. Mixer. 42 cubft. Robinson Ribbon Mixer. Vacuum Form. mach. 40x60". Dake 200 T Trimming Press. List your surplus equipment with me.—WANTED: 50T, 150 T Stokes—Standard Comp. press. 1½ to 4½" Extruders. Justin Zenner, 823 Waveland Ave. Chicago 13, Ill.

FOR SALE: 20 ounce Lester, New in 1952; 16 ounce H.P.M., New in 1953. Both machines fully equipped. Have been well maintained and are in excellent condition. May be seen in operation. Sterling Plastics Company, 1140 Commerce Avenue, Union, New Jersey.

FOR SALE: Steam Platen Presses 2000 ton 60"x46" also 200 ton French Oil Compression Molding Press, 300 ton and 400 ton 36"x36"—Carver Laboratory Presses—other Laboratory Presses up to 75 tons—6"x13" Laboratory Mills—¾" 3000 psi Double Solenoid and Cam operated Control Valves—Extruders—Jacketed Heating Kettles. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N.J. Telephone DEerfield 4-1615.

LIQUIDATION
Transfer Molding Presses, late type, self-contained
1—300 ton Stokes
2—200 ton Baldwin-Southwark
2—150 ton Stokes
1—100 ton Stokes
6—Thermall Preheaters.
Reply Box 2723, Modern Plastics.

FOR SALE: One (1) Standard DeMattia Model "G", Vertical, 12-ounce capacity injection molding machine Price—$6,500.00. Two (2) DeMattia Model "G2", Vertical, 4-ounce capacity with increased capacity heating cylinders, injection molding machines Price $4,500.00 each. All machines are operating and can be seen by appointment. Reply Owens-Illinois, P. O. Box 1035, Toledo 1, Ohio. Attn.: M. S. Carr.

FOR SALE: 2 oz. Van Dorn 1953, lever; 2 oz. Van Dorn 1952, semi-aut; 2 oz. Reed-Prentice, $1500; 4 oz. Impco, 1951. $5500; 4 oz. Reed-Prentice 1946, $4,000; 4 oz. Lewis, 1953; 4 oz. Moslo, 1956; 4 oz. Pecos w/8 oz. cyls. 1957; several 8 oz. Reed-Prentices. 1946/1951, $5500. up; 8 oz. Watson-Stillman; 8 oz. DeMattia; 8 oz. Lester; 12 oz. DeMattia, Model C, 1953; 12 oz. Reed-Prentice, 1951; 12 oz. Watson-Stillman, Model E; 16 oz. H.P.M.'s, 1948 & 1954; 16 oz. Reed-P; 16/20 oz. R-P, 1956; 20 oz. H.P.M. 1954; 20 oz. Lester 1951; 48 oz. Watson, 1950; 200 oz. H.P.M. 1955; vertical DeMattias, Watsons, Lesters, Impcos; double end tumblers, ovens, grinders, etc. Partial listing—other equipment available. Acme Machinery & Mfg. Co. Inc., 2315 Broadway, New York, N.Y. Su 7-1705.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton. 9" stroke, 14" ram, 36x36, @ $2150; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2450; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

FOR SALE: 1-Baker Perkins size 15USE, 100 gal. all stainless double arm Vacuum Mixer; 1-Baker Perkins size 15VUMM, 100 gal. double arm Mixer, 100 HP motor; 6-day 250 and 100 gal. double arm Mixers; 1-Ball & Jewell #1 Rotary Cutter; 2-Two Roll Mills 6"x12"; 6-Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 4-Stokes Model "R" single punch Preform presses; 1-Kux Model 15-25 Rotary Preform Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: 64 Oz. Injection Molder with Pre-Plasticizer, mold size 32"x50" 750 Ton clamp. Lester 8 oz. Model 2 ½L (1949). De Mattia 12 oz. (1946). De Mattia 4 oz. H.P.M. Rubber Injection molders, 21½" x28" mold space, steam heated platens. Watson Stillman 300 Ton Semi-Automatic Compression molding Press (1947) self-contained, mold size 34"x27". Watson Stillman 250 Ton 28"x24". Watson Stillman 140 Ton 22"x16". Waterbury Farrel 85 Ton 20"x24". W.F. 63 Ton 15"x15". Laboratory Presses—Elmes 20 Ton 8"x8", others 15 Ton 10"x8" and 10 Ton 6"x6" Platens. Scrap Cutters, Valves, Accumulators, Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 1—Hartig blown tubing take-up for a maximum lay width of 48" overall, consisting of one highly polished steel roll, and one neoprene coated roll for collapsing roll assembly, driven by ½ HP Servo Speed Drive and one dual wind-up station also driven by ½ HP Servo Speed drive. Dancer roll tension control for constant tension winding, air control valve and pressure indicator mounted on the frame of the tower.
1—1¼" die to produce up to 4" lay flat.
1—Machined precisioned aluminum air rings with specially designed baffles for uniform air flow. Reply Box 2707, Modern Plastics.

FOR SALE: One Impco vertical injection molding machine, Model VF 822A with 50 ounce vertical Preplasticizer. In excellent condition. Recently overhauled. Reply Box 2709, Modern Plastics.

FOR SALE: One Combination 2½" German Extruder and Blow Molding Machine, 1956 Model Automatic, Never Used, Wired to U. S. Specifications. Reply Box 2702, Modern Plastics.

FOR SALE: 4 oz. H.P.M. Rebuilt—excellent condition—now running. New West pyrometers, G. E. electronic timers, Vickers pump—$4900.00. Reply Box 2704, Modern Plastics.

FOR SALE: 1—530-ton Slabside French Oil Machinery Company 30" Front to Back x 54" Side to Side Hydraulic Compression Molding Press. 30" Diameter Ram 15" Stroke for 1500 PSI Double Acting Ram Knock-outs Timers "T" Slotted Table and Head Self Contained 15 HP Hydraulic Pumping Unit Bargain Prices Excellent Condition. Bedford-Bolling Company, Inc., 3190 East 65th Street, Cleveland 27, Ohio.

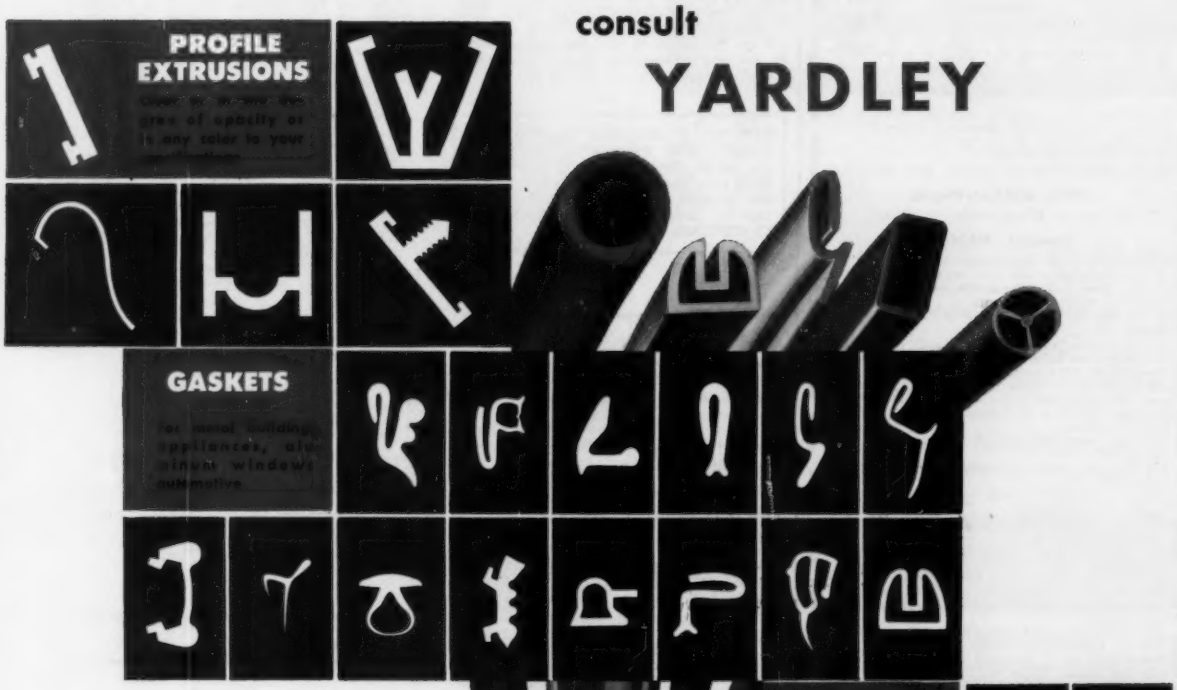
FOR SALE: 1—4½" Hartig Extruder with 50 H.P. Reliance Drive 1—48" Robbins Sheeting Die with complete take off equipment including shear and stacker. Many other accessories, too numerous to mention all. The above used about 3 weeks. Standard Plastics Company, 442 W. Garfield Blvd., Chicago 9, Ill. Atlantic 5-6300.

(Continued on page 318)

For extruded plastics in shapes like these

consult

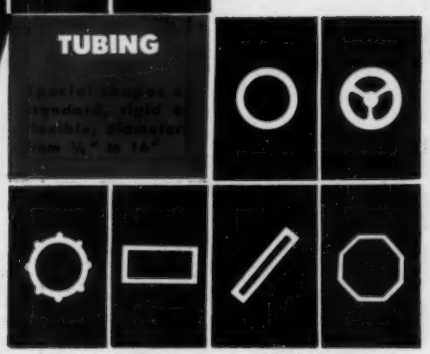
YARDLEY



What do you need . . . in production quantities? Yardley extrudes any shape in a variety of formulations to meet a wide range of design and performance requirements. Our engineers have developed advanced techniques that can save you time and money on exactly the right shape for your specific needs. If you require extruded plastics of consistent, uniform accuracy — or fabricated extruded parts — Yardley diversity and capacity are worth looking into.

Rigid and Standard Polyethylene
Rigid and Elastomeric Vinyl • Acrylic
Cellulose Acetate • Cellulose Butyrate
Kralastic • Styrene • Nylon • Cycolac

Our complete tool and die shop is staffed with skilled technicians. In addition, we maintain a library of over 300 section dies, one of which may fit your product design.



YOU DOODLE IT . . . WE'LL DO IT

These are just a few of the many, many shapes produced by Yardley. Send us your prints for quotation.

YARDLEY PLASTICS CO.
142 PARSONS AVE., COLUMBUS 15, OHIO

YARDLEY **MAIL COUPON FOR MORE INFORMATION**

Yardley Plastics Co.
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I am interested in learning how you can help us find better ways to solve our extruded plastics problems.

Name_____

Company_____

Street_____

City_____ Zone_____ State_____

Position_____

(*Continued from page 316*)

PLASTICS MACHINERY

Cutters, Rotary, Plastic

Lab & Small Cutters, ½ HP to 5 HP
Cumberland #1½ with 5 HP Motor
Ball & Jewell #1 with 10 HP MD
Ball & Jewell #2 Motor Driven, Extra Knives

Extruders

Hartig 4½" Elec. Htd. 96" Barrel, 40 HP. U.S. Vari-Drive.
Stokes—Windsor Model RC-100 Twin Screw 10 HP Vari-Speed Drive

Injection Molding Machines

2 Oz. Van Dorn, Oversize Cylinder, Model H-200
2½ Oz. Van Dorn, Full Automatic, Nylon Cylinder
8 Oz. Reed-Prentice, 20 HP Motor Drive
12 Oz. HPM Model H-300-12
16 Oz. Reed-Prentice No. 10-E-16, Elec. Htd., 1948

Mills, Rubber/Plastic

18" x 50" Farrel, Rubber/Plastic, 75 HP MD

Presses, Molding

15 Ton Baker Fully Automatic
15 Ton Stokes No. 200 D-2 Automatic (10)
30 Ton Baker Full Automatic Model 958, Excellent Condition, New 1951
40 Ton Francis, 4 Opening, 12" x 12" Elec. Heated Platens
50 Ton Stokes, Semi-Auto., Self Cont.
75 Ton Watson-Stillman Fully Automatic, 20" x 20" Platen 5 HP MD
100 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
100 Ton Lake Erie Hi-Speed, 24" x 24" Bed, 12" DLO, Self Cont.
113 Ton French Oil Mill, 6 Opening, Elec. Htd., Platens 15" x 18"
113 Ton R.D. Wood, 5-Opening Elec. Htd. Platens 14" x 20"
150 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
175 Ton Viceroy Slab-Side 24" x 24", Elec. Htd. Platen with Hand Pump
200 Ton Stokes Semi-Automatic, Power System, Timing Controls
225 Ton Farrel 14" Ram x 18" Stroke, L-R 26½" x F.B. 24½" 7½ HP MD
300 Ton Stokes Semi-Automatic, Power System, Timing Controls
300 Ton Dunning & Boschert 30" x 30" Platen
314 Ton Lake Erie 36" x 36" Semi-Automatic, Push Button Controls 10 HP Pump & Motor
625 Ton Farrel, Steam Platens 52" x 52", Pump, Mtr., Controls, Under Power

Furnaces and Ovens

Megatherm, 3/60/220, 3 KW, 2-3 lb. Phenolic Per Min. (8)
Despatch Mdl. P1hd-8 8 Drawers, 12 x 18 x 2½" (2)

Tablet Machines

Model "E" Stokes, Complete with MD
Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP
No. RB-2 Stokes, 16 Station, Motor Drive, 2 HP
Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD
Model F, Stokes, Single Punch, MD
No. 5 Arthur Colton, Motor Drive, 3 HP
No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP
Model T Stokes Hydraulic Equalizer, MD
Model 280-G Stokes Preform Press. 100 Ton Dual Pressure—Late

Mixers

Model "B" Banbury Lab type. Never used
No. 3A Banbury, 150 HP Md Rubber/Plastic
No. 3 Banbury 75 HP MD Excellent Condition Slide Door Construction

Calenders

6" x 16" Thropp, 3 Roll Chrome Plated, 7½ HP Vari-Speed
9" x 48" American Tool 4 Roll Doubling, Belt Drive
6" x 13" Elec. Htd. 6 Roll Lab Type, 7½ HP MD

Pelletizers

Mitts & Merrill Model 10-N-6 15 HP V.S. Drive

Make Us Your Prime Source for All Types of Plastics Machinery

Hydraulic Presses from lab size to 5,000 ton
Injection Molders from ¼ oz. to 60 oz. size
Extruders from lab size to 12"
Plastic & Rubber Mills and Calenders up to 84" size
Tablet Preform Presses, single punch and rotary, all sizes
Mixers all sizes, types and capacities

Also a complete selection of tumbling barrels, take-up equipment, hydraulic power units, pumps, ovens, blenders, scrap cutters, pelletizers, coating equipment and laminating equipment.

JOHNSON MACHINERY Co.
683-P Frelinghuysen Ave., Newark, N.J.
What Do You Need? What Have You To Sell?

FOR SALE: All in stock—1—6"x13" lab. mill. 2—50" mills. 3—4'x7' Vulcanizers, ASME 125# WP, 650° F, Quick-opening doors. 3400 HP Farrel-Birmingham horizontal reducer. 7500 HP Falk horizontal reducer. 40 HP rotary knife cutters or rubber hogs. 6 oz. Injection Molders—1942 Watson-Stillman, 1947 Lester. Double arm sigma blade mixers—2¼, 5, 10, 20, 30, 60, 75, 100, 150 gal., stainless steel and steel. Rotary & single punch Tablet or Preform Presses—Stokes "R", "T", "DD-2", "RD-4", Kux rotary 21, 25 punch. We want to buy your idle, space-consuming equipment. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: Injection Molding Machines—HPM 9-oz. 1941—Impco 4-6 oz. purch. Nov. 1950. very little use. Both machines in excellent cond. and can be seen in operation. Sunset Plastics Co., 2163 Elizabeth St., Salt Lake City 6, Utah.

Materials for sale

SCRAP FOR SALE: 5 M lbs. of clean, rigid vinyl plastic. Mixed clear and white. Will sell to the highest bidder. Plastic Fabricators Co. Inc., 440 Sansome Street, San Francisco, California.

GENERAL PURPOSE VIRGIN STYRENE: 5750 lbs L 1171 Pink (Std). 2950 lbs. K 1978 Red, 3150 lbs. K 165 Peach. 3300 lbs. K 287 Green, 3500 lbs. P 33569 Green, 2000 lbs. P 42576 Tan, 5850 lbs. P 23553 Charcoal, 8150 lbs. K 525 Gray, 3783 lbs. P 23136 Gray, 3472 lbs. 9049 Blue Pearlescent. 4000 lbs. H 1544 Grey HI Impact. 3215 lbs. A 23095 M Black Acetate (Flame Retardant). 1475 lbs. 405 Black Plexene. Plastic Molded Products Co., 6044 N. Pulaski Rd., Chicago 30, Illinois.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
Reply Box 2717, Modern Plastics.

WANTED: Injection products that would fit into the houseware-hardware field. Send product sample, quantity runs, price of same. State whether mold can be bought outright. The Shel-Den Co., 293 N.E. 61 St., Miami, Florida.

POLYETHYLENE SCRAP WANTED: Acetate, Butyrate, Acrylic In Any Form. Claude P. Bamberger, Inc., One Mount Vernon Street, Ridgefield Park, N.J. Telephone: HUbbard 9-5330.

WANTED.
Vinyl, polyethylene and styrene scrap for our manufacture of molding and extrusion compounds. We can use rigid from vacuum forming, lumps, bleeder, slabs, trimmings, rejects—anything suitable for reprocessing. Send samples and details or telephone. Steady buyers since 1940. Rotex Rubber Company, Inc., 1-23 Jabez Street, Newark 5, N.J. MArket 4-4444.

Molds for sale

FOR SALE: One 4 cavity 12"x12" mold of 4 non-interchangeable Disney Characters—Mickey Mouse, Donald Duck, Pluto, Minnie Mouse. One 4 cavity 12"x 12" mold with interchangeable cavities of Ginger Boy, Chick, Cinderella, Prince Charming, Jac, Gus, Indian, Cowboy, Cowgirl, Horse, Happy Birthday, Turkey, Star, Bell, Santa (2 cavities) and Tree. These molds are made to fit a 4 or 6 oz. Crown Machine but could be modified to fit others by addition of clamping slots. Molds are in good operating condition. If interested, contact Loma Plastics, Inc., 3000 W. Pafford, Fort Worth, Texas.

FOR SALE: Wall Tile Mold, designed with two bevels, very outstanding, four cavities used about one month. Is in first class condition just like new, will sell at 50% of cost. Samples on request. Derby-Shelton Silver Company, Shelton, Connecticut.

FOR SALE: Injection Molds. Napkin holder, spice rack, round canister, manicure caddy, hostess serving tray, ice bud tray, trivet, circus toy. Priced low for easy sale. Reply Box 2705, Modern Plastics.

FOR SALE: Houseware molds, comb molds, also some novelty and specialty items. All in excellent condition. No reasonable offer refused. Send for list. Reply Box 2714, Modern Plastics.

Molds wanted

MOLDS WANTED: For export. All kinds of toys, household items, ladies buttons and novelties, to be used in 2½ to 12 oz. machine. Reply: Sovereign International Corp. 110-01, 63rd Drive, Forest Hills 75, N.Y.

WANTED: Used molds for plastic pipe fittings. Reply Box 2706, Modern Plastics.

WANTED: Injection molds—one item or complete line of proprietary consumer articles, also interested in molds for industrial parts such as knobs, handles, fasteners, boxes, etc. Will consider purchasing complete injection plant with end products or parts line. Designers: New items wanted—cash or royalty. Victory Mfg. Company, 1722 West Arcade Place, Chicago 12, Ill.—Estab. 1930.

Help wanted

CHEMIST: Experienced factory production calendered sheeting. Real opportunity. Metropolitan N.Y. area. Reply Box 2711, Modern Plastics.

CHEMIST OR CHEM. ENG.: graduate B.S. or M.S. Minimum 5 yrs. exp. Epoxy and Phenolic Resin R and D, reinforced and casting products preferred. Send complete resume including salary requirements. Locate in Los Angeles Area. Reply Box 2721, Modern Plastics.

(*Continued on page 320*)

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Gering consistently pays top prices for thermoplastic scrap . . . all types and forms . . . including rejects and obsolete molding powders.

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Conversion to
NYLON-GEAR
BY SMALL-LOT
MOLDING PROCESS

ACTUAL SIZE ACTUAL SIZE

SAVES 26¢ PER UNIT

This Zytel 101 Nylon Beveled Gear replaced a machined gear that formerly cost 59¢ each. After the initial tooling costs we die-molded it in one operation by our special injection process at 33¢ each.

COST ANALYSIS:
Tooling, set-up and first 100 pieces, including material and trimming **$286.00**

Additional 100 lots: $33.00

In addition to a cheaper piece price and equal wearing qualities, the Nylon Gear proved rustproof, noiseless, required no oiling and weighed less.

Let us quote on your Short-Run Plastic Moldings. We will gladly submit quotations without obligation.

DAYTON ROGERS
Manufacturing Company

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We are looking for a man with a degree in chemistry or chemical engineering who has solid experience in the formulation, manufacture, and application of phenolic molding compounds to take part in our development of a new raw material.

The man we engage will work at a completely modern, fully equipped, capably staffed research center in the Pacific Northwest. In addition, he will be responsible for important field contacts.

If you feel qualified, write us giving pertinent background information and desired salary. All replies of course will be held in strict confidence.
Box 2730, Modern Plastics.

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EXTRUSION OPERATOR FOREMAN—Thorough knowledge of polyethylene film extrusion, mechanical background preferred. Located New York City. High salary. Reply Box 2712, Modern Plastics.

CHEMICAL ENGINEER: Resins and Plastics. A leader in the Chemical industry with established and expanding product line of synthetic resins has a challenging opening for an experienced development engineer. Applicant should have a B.S. or M.S. in Chemical Engineering with 5-8 years experience with special emphasis on the manufacture of resins and plastics. The position involves pilot plant synthesis and development of new existing resins at central staff installations on the East Coast over 100 miles from New York City. If interested, please send resume (no reference check without permission) with salary history to: Reply Box 2716, Modern Plastics.

PLASTICS SUPERVISOR: Leading Midwest extruding and vacuum forming company has opening for experienced production foreman. Permanent position for man with sheet extrusion and vacuum forming experience. Excellent opportunities for advancement. Salary open. Send complete resume to Reply Box 2719, Modern Plastics.

PERSONNEL: Executive—Technical—Sales—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 220 South State, Chicago 4, Ill.—WAbash 2-4800. Call, write or wire—in confidence.

EXTRUSION SPECIALIST: Man with knowledge of all phases of the extrusion field, including machine set-up, ability to handle people. Reply Box 2700, Modern Plastics.

REINFORCED PLASTICS Sales Engineer: Large multi-plant corporation has opening in Detroit office for aggressive, personable sales engineer. Experience required in application engineering and sales of pre-mix and pre-form molded parts or related materials to automotive industry or its vendors. Age 25-35. Send complete resume including experience, education, personal history, and salary requirements. Reply Box 2715, Modern Plastics.

REPRESENTATIVES: With technical background to sell pre-impregnated materials for molding, laminating, post forming, required in all territories by well-known plastics manufacturer now expanding operations. Excellent potential, liberal commission. Previous experience selling fillers and reinforcing materials desirable but not required. Reply Box 2726, Modern Plastics.

SALES REPRESENTATIVES: Leading Eastern plastics fabricator, with excellent facilities for forming and precision machining of acrylics, plans to add several sales representatives, in an expansion program. Write fully. Reply Box 2722, Modern Plastics.

SALES REPRESENTATIVES: Wanted to cover various sections of the country, to sell complete line of roll leaf for hot stamping on all types of plastics and plastic products. Write or phone for appointment. Admiral Coated Prods, Inc., 38 Tiffany Place, Brooklyn 31, N.Y. Ulster 5-3350.

EXPERIENCED SALESMEN: FOR MOLDING COMPOUNDS—Old, established plastic materials manufacturer has openings in several territories for experienced molding compounds salesmen. Wonderful opportunity. Our staff knows of this ad, so write in complete confidence. Reply Box 2703, Modern Plastics.

MANUFACTURERS REPRESENTATIVES: Rapidly expanding manufacturer of plastic containers and custom molded articles seeking top flight representation throughout the country. Straight commission in protected territories. Reply Box 2729, Modern Plastics.

Situations wanted

POSITION WANTED: At present technical director AaA-1 company division operating in non-ferrous foil rolling, extrusion, laminating, coating, vacuum metal evaporation. Metals, papers, boards, films, adhesives and colors. Electronics, containers and structural. Military and commercial. Technical and policy. Wish to change; available for one or two days per week on permanent basis. Reply Box 2718, Modern Plastics.

TECHNICAL SALES MANAGER: Sound knowledge of extrusion and physical properties of most thermoplastics, plus ten years of executive experience in sales, sales promotion, finance, etc. Seeking position with raw material supplier or with company preparing to enter extrusion field. Reply Box 2725, Modern Plastics.

ENGINEER: Executive age 30 with B.S. in Engineering desires responsible position with aggressive company offering chance for advancement. Eight years experience in plastics and allied fields. Fully familiar with plant management, sales and customer contact. Geographic location not important. Will relocate if necessary. Reply Box 2713, Modern Plastics.

EXTRUSION ENGINEER: 10 years of practical experience in all types of precision custom work and in all materials. Capable of complete plant charge, expansion, and development work. Willing to invest in right setup. Reply Box 2724, Modern Plastics.

Miscellaneous

PLASTIC SLIDE FASTENER (Zipper): Patentee would like to get in touch with a leading plastic processor, on a manufacturing license basis, for the manufacture of slide fasteners, on extruders, in P.V.C. Polyethylene and Polyamide. Both the closing strip and also the slider patented in the U.S.A., Canada and Mexico. This slide fastener has already been well introduced in many leading countries. Reply Box 2701, Modern Plastics.

WANTED: Manufacturers, send prices and description of houseware, toy and novelty merchandise for retail outlets. Lake Plastics Company, 30335 Euclid Ave., Wickliffe, Ohio. c/o Arnold M. Dowis.

MERGER OR PURCHASE: Injection Molding Plant with machines to 12-oz. capacity. Tax loss desirable. Forward details of equipment and tax status to Reply Box 2708, Modern Plastics.

SYNTHETIC RESINS, CHEMICALS, PLASTIC GOODS: Important North European company, engaged in thermosetting resins manufacture (phenolic, maleic, alkyd and urea resins, synthetic adhesives, phenolic moulding powder) and in the manufacture of thermoplastic goods (P.V.C. in sheets, rods and laminates), is interested in obtaining licenses for exclusive products in both fields, particularly thermoplastic goods. Resin kettles are standard type for chemical reactions and could be employed partly or exclusively for new products. Managing Director of the company will be in New York early in October. Reply Box 2710, Modern Plastics.

NEW PRODUCT IDEA AVAILABLE: Patentable nursery accessory and toy. Has national distribution potential. Retail $1.00 to $1.49. Can be injection molded, or, fabricated from bar stock plastic. Tooling cost low. Working models available. Will sell for small initial sum and royalty. H. S. Downing, Box 627, Fayetteville, N. C.

CONTACT: with specialized distribution organizations in U.S.A. and other countries except Europe, desired. West-German manufacturers of plastics processing equipment with long years of experience offer interesting new designs: a) presses, special jigs, preforming machines and profiling equipment for reinforced plastics and thermoplastic materials. b) vacuum forming equipment, especially for thick sheets and polyethylene forming as well as packagings. First-class workmanship—favourable prices. Present delivery periods are from 3 to 5 months. We supply also complete plants including technical and commercial advice by our Division "A": plastics processing. Reply Box 2720, Modern Plastics.

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Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

U.S.A. enquiries to: J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to: Canadian Industries Ltd., Plastics Dept., Box 10, Montreal, P.Q.

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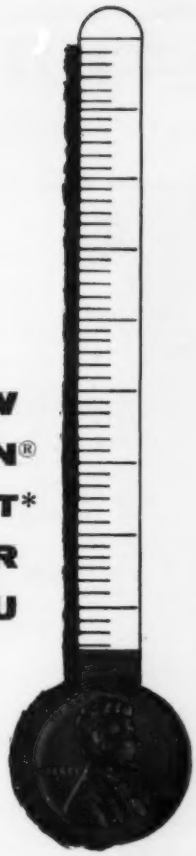

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*Low temperature

Comparison of Plastolein 9078 with di-decyl adipate

	Plast 9078	DDA
Parts Geon 101	100	100
Parts Plasticizer	48	49
Tensile, psi	2650	2400
Elongation, %	365	360
Modulus, 100%, psi	1130	1240
Hardness, D.10 sec.	85	89
Volatility, SPI, 70° C		
1 day-mg/in²	1.9	2.3
7 days-mg/in²	8.0	9.1 Borderline at
Masland Impact, °C	—40	—40
Extraction, mg/in²		
Water, 24 hrs. @ 50° C	0.2	0.1
Soapy Water, 24 hrs. @ 50° C	1.0	0.4
Min. Oil, 24 hrs. @ 25° C	11.1	19.8
Compatibility, Roll Spew	Slight	Severe

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio, Dept. F10A

☐ *Please* send descriptive literature on Plastolein 9078

☐ *Please* send a pint evaluation sample

☐ *Please* send a technical representative

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Emery Organic Chemical Sales Department

Emery Industries, Inc. Carew Tower, Cincinnati 2, Ohio

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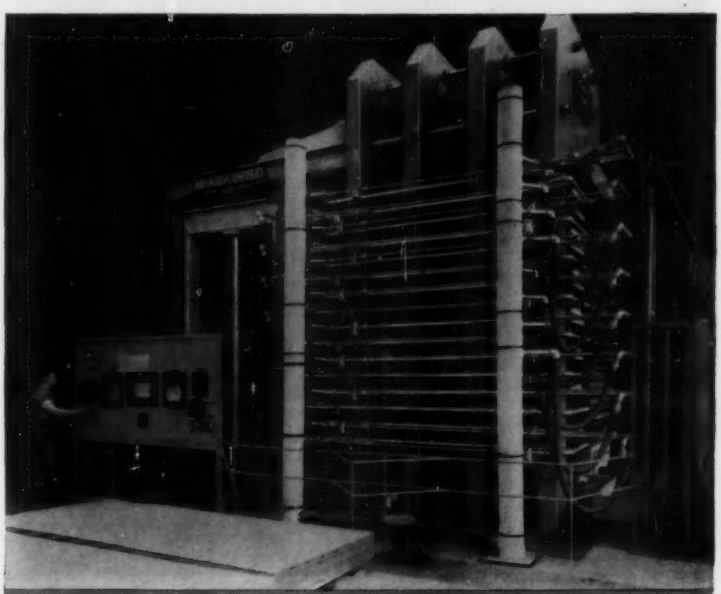

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For more information about G-E phenolic molding powders, write General Electric Company, Section MP-10, Chemical Materials Dept., Pittsfield, Mass.

Progress In Phenolics

GENERAL ELECTRIC